NORTH CENTRAL MANITOBA
ELECTRIFICATION STUDY

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We would also like to express our appreciation to the communities' Band Chiefs and members of the Island Lake Tribal Council Executive for their participation in the study and for their involvement in the public participation program throughout the study.

The following Chiefs formed the initial Management Committee which maximized community participation and involvement:

Chief Joe Guy Wood	St. Theresa Point
Chief Larry Monias	Garden Hill
Chief John J. Harper	Waasagomach
Chief Billie Harper	Red Sucker Lake
Chief Doug Hastings	Gods Lake Narrows
Chief Percy Okimow	Gods River
Chief Dennis Grieves	Oxford House

Following several elections during the study, new Band Chiefs replaced some of the original Management Committee and carried the study to completion. These new Chiefs are:

Chief Billy Joe Flett	St. Theresa Point
Chief Percy Flett	Garden Hill
Chief Leonard McDougall	Red Sucker Lake
Chief Eric Chubb	Oxford House

EXECUTIVE SUMMARY

Manitoba Hydro has, over the past decade, provided electric energy to the North Central communities of Garden Hill, Gods Lake Narrows, Gods River, Oxford House, Red Sucker Lake, St. Theresa Point, and Waasagomach. This electric energy is generated by means of local diesel generating plants located in each community and distributed through local, independent distribution systems.

The use of electrical energy in each of the communities is restricted to 240 volt, 15 amp service for standard residential customers and 240 volt, 30 amp service for standard general service customers. Customers requiring unlimited electric energy can obtain this type of service under a special agreement with Manitoba Hydro whereby they pay the full cost of providing the service. These charges are considerable and include monthly energy charges as well as a one-time front-end generation charge of anywhere from $545 to $2,130/kw. The energy and generation costs relate to Manitoba Hydro's incurred costs to finance, construct, operate, maintain, expand, and replace the plant and equipment supplying the energy. The charges vary from time to time and from community to community.

Continuing long-term escalation in the cost of both fuel oil and its transportation to the communities, as well as the Canadian Government's off-oil initiative prompted the Island Lake Tribal Council to apply on behalf of all the North Central communities for the funding of a study under the Remote Community Demonstration Program. The study was to identify feasible

alternatives for the supply of economical, unlimited electrical energy to the customers in the seven communities. The funding to carry out the study was made available jointly by the Department of Energy, Mines and Resources and the Department of Indian Affairs and Northern Development.

Under existing conditions, Manitoba Hydro provides diesel-generated electric energy to the communities and has incurred large annual losses. It is anticipated that due to the continuing escalation of fuel oil prices and transportation costs, these losses will continue to rise. In order to examine feasible alternatives to diesel generation, population and electrical consumption projections were prepared, based on current statistics.

Existing consumption in the communities was divided into the major consumer groups: residential, street lighting, general service commercial, federal government funded facilities, and provincial government funded facilities.

The most critical assumptions in projecting load growth in communities, where very little commercial and industrial load growth is anticipated, are those associated with space heating of residential, commercial and institutional facilities. A review of Manitoba Hydro statistics for other northern communities provided with unrestricted electrical energy shows that in the majority of cases, residential customers in those communities presently opt for all-electric service which includes electric space heating. This despite the fact that in many cases, wood is readily available, more economical, and may be necessary for standby emergency heating. The overriding con-

siderations with residential customers seem to be the safety, reliability, and convenience of electric heating systems. Should the cost of electrical energy continue to escalate, the general acceptance of electric heat may change, but this has not yet occurred. General service customers including government funded agencies presently utilize fuel oil to provide the majority of space heating requirements in the North Central communities, with a relatively small percentage of space heating being provided by wood and propane. Residential customers presently use wood for space heating requirements.

Once energy demands and peak loads were established, the following electrical energy supply alternatives were reviewed:

1. Central System Supply

A transmission system connection from the northern Manitoba Hydro grid to the North Central communities was investigated in detail. This transmission line would be approximately 160 km long and would originate at Kelsey Station near Kelsey and would terminate at Oxford House, the closest North Central community to Kelsey. The individual communities would be interconnected with a transmission grid. Other transmission system connections to the Manitoba Hydro northern and southern transmission grid were considered but not investigated further due to much higher capital costs.

Connection of each community to the transmission grid will require either new transformer stations to interface to the existing commu-

nity distribution systems or upgrading of the community distribution systems to permit direct connection to the grid. The costs of the various alternatives were investigated on a community basis and only the most economic alternative was considered.

Individual householders and commercial and institutional customers would have the option of upgrading their services to make full use of the electrical energy available to the same degree as a southern consumer. This cost, however, would be the responsibility of each consumer.

2. Local Hydro Generation Alternative

Seven potential hydro sites were identified and studied in detail. A site reconnaissance was also carried out to verify the available data for each site and to assess and ascertain site-specific features.

The sites are located on the Gods, Kanuchuan, and Island Lake Rivers which in turn are connected to Gods Lake and Island Lake, the two major lakes characterizing the study area.

Although other sites in the area may have the potential for development, the sites chosen can be considered representative and offered the added advantage of making use of virtually the entire head available on the rivers.

Each hydro development would be connected to a transmission grid which in turn would provide the electrical interconnection between the communities and the hydro plants. Transmission grid voltages were selected, based on preliminary load flow studies. As a result of these voltages, new transformer stations and upgrading of some of the existing community distribution systems would be required to facilitate connection to the transmission grid.

3. Alternative Energy Systems

A variety of alternative energy sources for generation of electrical power were also analyzed. These included:

- Diesel generation
- Wood-fired boiler/steam turbine generation
- Wood gasification dual-fuel engine generation
- Solar energy generation
- Wind energy generation
- Peat-fired steam turbine generation
- Hybrids

For the purposes of this analysis and for technical and economic reasons, an energy supply from a centralized plant, located at Gods Lake Narrows, was deemed preferable and all units were assumed to be located at this site.

While advanced technology has been reviewed, only proven technology has been considered and evaluated. A preliminary screening of all of the above primary alternatives revealed that only the diesel generation and wood-fired boiler/steam turbine generation

alternatives, as well as a solar extension to each of the above, were economically viable solutions.

After reviewing the three categories of alternatives discussed above, it was determined that on an economic and technological basis, the central supply system and the local hydro generation alternatives were the most feasible choices, warranting detailed analysis. This analysis was carried out and, based on an economic comparison, the Central System Alternative proved to be the most viable by a wide margin.

The economics of the various alternatives considered were compared by calculating the present worth as at January 1, 1989 of all capital, operating, maintenance, and fuel costs not common to each alternative over the period to 2015. The results of this comparison are summarized below.

Alternative/Item	Present Worth in Millions $ at Discount Rates of		
	4%	6%	8%
Central System Supply Alternative			
Fixed Charges - transmission line	9.68	10.55	11.31
- transmission grid	22.28	22.82	23.12
Operation and maintenance - line	1.84	1.59	1.30
- grid	3.84	3.19	2.60
Energy Costs	14.28	11.00	8.68
Total	51.92	49.15	47.01
Local Hydro Supply Alternative			
Fixed Charges - hydroelectric plants	57.12	64.15	68.05
- transmission grid	18.13	18.52	18.82
Operation and Maintenance - plants	10.59	8.78	6.76
- grid	3.07	2.58	2.10
Total	88.91	94.03	95.73

Local Thermal Supply Alternative - Biomass

Fixed Charges - generation plant	45.15	44.07	42.83
- transmission grid	18.13	18.52	18.82
Operation and Maintenance - plant	23.75	18.50	14.74
- grid	3.07	2.58	2.10
- variable	1.99	1.53	1.21
Fuel Costs	61.29	47.22	37.24
Total	153.38	132.42	116.94

Local Thermal Supply Alternative - Diesels

Fixed Charges - generating plant	20.56	19.52	18.58
- transmission grid	18.13	18.52	18.82
Operation and Maintenance - plant	12.35	9.62	7.66
- grid	3.07	2.58	2.10
- variable	8.25	6.36	5.02
Fuel costs	55.93	43.09	33.99
Total	118.29	99.69	86.17

Note: The above present worth figures are for relative comparison purposes only, and cannot be used to calculate the price of energy to the customer.

A preliminary environmental evaluation was prepared for the two primary alternatives. Impacts arising from a central supply system would be primarily associated with trapping. Line construction in the winter might disturb wildlife along the right-of-way, causing them to move out of the area, and resulting in a temporary decreased fur harvest. Trappers might require compensation, but the impact would be temporary. Some increased hunting of ungulates along the right-of-way is a potential long-term impact. The local hydro generation alternative would result in both of these impacts as well. The most serious impacts of small hydroelectric generating stations would be the destruction of the prime brook trout habitat and interference with fish passage in the Gods Lake area. Brook trout populations would decline and lodges depending on the species for attracting business would be negatively affected.

A preliminary socio-economic assessment showed that the primary impacts would be similar for the two alternatives. Upgrading of the electrical system in the North Central communities would offer temporary employment and income opportunities for interested local residents. Local roads may require upgrading for the project which could in the long term benefit the communities. However, those residents opting to upgrade their electrical services would experience a continuing cost increase due to their increased use of electricity, with or without electric space heating. The significance of this increase would depend on their assessment of a superior electrical supply.

The results of this study were reported to the residents of the communities in order to elicit public comment and discussion. The residents, virtually unanimously, opted for the recommended alternative, a connection to the Manitoba Hydro Central Grid at Kelsey. Furthermore, the residents in some of the communities rejected completely the Local Hydro Generation Alternative as a result of the potential impact on the natural resources in the area.

In conclusion, the preferred option for the provision of unrestricted electric service to the North Central communities from economic, environmental, social, and public aspects is a connection from the communities to the Manitoba Hydro Central Grid at Kelsey.

ETUDE D'ELECTRIFICATION DU CENTRE-NORD DU MANITOBA

Résumé pour la Direction

Au cours de la dernière décennie, la Manitoba Hydro a approvisionné en électricité les collectivités de Garden Hill, Gods Lake Narrows, Gods River, Oxford House, Red Sucker Lake, St. Theresa Point et Waasagomach, situées au Centre-nord de la province. Cette énergie électrique est produite par des génératrices diesel situées dans chaque collectivité et est distribuée par des réseaux locaux indépendants.

Dans chacune des collectivités, la consommation d'énergie électrique est limitée à 240 volts et 15 ampères pour les usagers du secteur résidentiel et à 240 volts et 30 ampères pour les usagers généraux. Les clients qui désirent avoir accès à une quantité illimitée d'électricité peuvent obtenir ce type de service en concluant avec l'Hydro-Manitoba une entente particulière en vertu de laquelle ils s'engagent à payer tous les coûts engendrés par la prestation de ce service. Ces frais considérables comprennent des frais mensuels ainsi que des frais initiaux d'installation en un versement qui peut varier de 545 $ à 2 130 $ le kilowatt. Ces frais correspondent aux sommes déboursées par la Manitoba Hydro pour financer, construire, exploiter, entretenir, agrandir et remplacer les installations et les biens d'équipement servant à fournir l'énergie. Ces frais varient de temps à autre ainsi que d'une collectivité à une autre.

La croissance continue et à long terme du coût du mazout et du transport de ce combustible aux collectivités éloignées, ainsi que le Programme de remplacement du pétrole du gouvernement canadien, ont incité le Conseil tribal d'Island Lake à présenter une demande au nom de toutes les collectivités du Centre-nord afin d'obtenir les fonds nécessaires pour l'exécution d'une étude dans le cadre du Programme de démonstration dans les collectivités éloignées. Cette étude doit permettre de déterminer d'autres moyens pratiques de fournir, aux abonnés des sept collectivités, une quantité illimitée d'énergie électrique à un coût acceptable. Les crédits nécessaires à l'exécution de l'étude ont été fournis conjointement par le ministère de l'Energie, des Mines et des Ressources et par le ministère des Affaires indiennes et du Nord.

A l'heure actuelle, l'approvisionnement de ces collectivités en énergie électrique produite par génératrices diesel entraîne des pertes annuelles importantes pour la Manitoba Hydro. Il est prévu que ces pertes continueront de croître en raison de l'augmentation continue des prix de mazout et des coûts de transport de ce combustible. Pour déterminer les moyens pratiques de remplacer les génératrices diesel, des projections relatives à la population et à la consommation d'électricité ont été préparées en fonction des données statistiques existantes.

L'étude de l'énergie consommée à l'heure actuelle dans ces collectivités a été effectuée en fonction des principales catégories de consommation, à savoir: le secteur résidentiel, l'éclairage des rues, le secteur commercial général, le secteur public fédéral et le secteur public provincial.

Les hypothèses les plus importantes qui sous-tendent les projections de croissance de la charge dans les collectivités, où l'on ne prévoit qu'une augmentation très minime de la charge requise par les entreprises commerciales et industrielles, sont celles qui se rapportent au chauffage des logements, des immeubles commerciaux et des institutions. Une analyse des statistiques de la Manitoba Hydro relatives à d'autres collectivités septentrionales dont l'approvisionnement en électricité est illimité révèle que, dans la plupart des cas, les abonnés du secteur résidentiel dans ces collectivités choisissent l'électricité comme seule source d'énergie pour tous leurs besoins, y compris le chauffage. Ils choisissent l'électricité en dépit du fait que, dans de nombreux cas, le bois est une source d'énergie plus accessible, plus économique et parfois nécessaire comme source de remplacement en cas de panne. Pour ces abonnés, il semble que les considérations les plus importantes soient que les systèmes de chauffage électrique soient des modes sûrs, fiables et commodes. Si le coût de l'énergie électrique continue de croître, il se pourrait que cette forme de chauffage devienne moins acceptable mais ce n'est pas encore le cas. Dans les collectivités du Centre-nord de la province, les usagers généraux, y compris les organismes financés par les gouvernements, utilisent actuellement du mazout pour répondre à la majeure partie de leurs besoins de chauffage, bien que le bois et le propane servent à fournir une part relativement minime de ce chauffage. A l'heure actuelle, les usagers du secteur résidentiel utilisent le bois comme mode de chauffage.

Une fois la demande d'électricité et les charges de pointe établies, les sources de remplacement suivantes ont été examinées:

1. Raccordement au système central

La possibilité de raccorder les collectivités du Centre-nord au réseau septentrional de la Manitoba Hydro a fait l'objet d'un examen détaillé. La ligne de transport dont la longueur serait d'environ 160 kilomètres relierait la centrale située près de Kelsey et Oxford House, la collectivité la plus rapprochée. Les collectivités individuelles seraient interreliées au moyen d'un réseau de distribution. D'autres possibilités de raccordement aux réseaux exploités par la Manitoba Hydro dans le Nord et dans le Sud ont été prises en considération mais n'ont pas été analysées plus à fond en raison des coûts en capital élevés.

Le raccordement de chaque collectivité au réseau de distribution nécessitera soit l'installation de nouveaux transformateurs pour permettre la liaison aux réseaux de distribution existants, soit l'amélioration des systèmes de distribution pour permettre le raccordement direct au réseau. Les coûts occasionnés pour chacune des collectivités par les différents moyens proposés ont été calculés et seules les solutions les plus économiques ont été retenues.

Les usagers individuels ainsi que les entreprises commerciales et les institutions auraient la possibilité d'améliorer leurs services afin de tirer pleinement partie de l'énergie électrique disponible, au même titre que les consommateurs du sud de la province. Toutefois, chacun des consommateurs devrait assumer les coûts engendrés.

2. Centrales hydro-électriques locales

Sept sites possibles de centrales hydro-électriques ont été déterminés et examinés en détail. Des travaux de reconnaissance ont été effectués pour vérifier les données existantes sur ces sites ainsi que pour évaluer et définir les caractéristiques propres à chaque site.

Les sites en question sont en bordure des rivières de Gods, de Kanuchuan et d'Island Lake qui se déversent à leur tour dans le Gods Lake et l'Island Lake, les deux principaux lacs de la région à l'étude.

La région renferme d'autres sites dont l'exploitation pourrait être avantageuse mais ceux qui ont été retenus sont jugés plus caractéristiques et ils offrent en plus l'avantage de pouvoir exploiter pleinement la hauteur de chute des rivières.

Chaque centrale hydro-électrique projetée serait reliée au réseau de distribution qui servirait, à son tour, à assurer la liaison entre les collectivités et les centrales. Les niveaux de tension du réseau ont été déterminés en fonction d'études préliminaires des variations cycliques de la charge. Compte tenu des niveaux de tension prévus, il serait nécessaire d'installer de nouveaux transformateurs et d'améliorer les systèmes de distribution existants dans les collectivités, en vue de faciliter le raccordement au réseau de distribution.

3. Autres systèmes de production de l'électricité

Divers autres modes de production d'énergie électrique ont aussi été analysés, notamment:

- les génératrices diesel
- les systèmes combinés chaudière au bois-turbine à vapeur
- les systèmes à deux carburants (moteur diesel-gazogène à bois)
- les systèmes de conversion de l'énergie solaire
- les systèmes de conversion de l'énergie éolienne
- les turbines à vapeur alimentées à la tourbe
- les systèmes hybrides

Aux fins de la présente analyse et pour des raisons d'ordre technique et économique, il a été jugé préférable de supposer que la production d'énergie était centralisée à Gods Lake Narrows et que, par conséquent, toutes les génératrices y étaient regroupées.

Les techniques avancées ont été prises en considération mais seules les techniques éprouvées ont été retenues et évaluées. Un examen préliminaire de toutes les méthodes énumérées précédemment a révélé que seuls les systèmes combinés chaudière au bois-turbine à vapeur et les génératrices diesel auxquels seraient ajoutés des systèmes de conversion de l'énergie solaire seraient rentables.

Par suite de l'examen des trois catégories de mesures exposées précédemment, il a été déterminé, en fonction de critères économiques et techniques, que le raccordement au système central et la construction de centrales hydro-électriques locales constituaient les solutions les plus

pratiques et qu'il convenait de les analyser de façon plus approfondie. Ces deux sources d'énergie ont donc été comparées du point de vue économique et le raccordement au système central s'est avéré nettement plus avantageux.

Les diverses méthodes analysées ont été comparées du point de vue économique en calculant la valeur actualisée au 1er janvier 1989 de tous les coûts de capital, d'exploitation, d'entretien et de combustible engendrés par chaque méthode jusqu'en l'an 2015. Les résultats de ces comparaisons sont présentés ci-après sous forme de tableaux.

Méthode d'approvisionnement ou de production	Valeur actualisée en millions de dollars selon des taux d'actualisation de		
	4 %	6 %	8 %
Raccordement au système central			
Frais fixes - ligne de transport	9,68	10,55	11,31
- réseau de distribution	22,28	22,82	23,12
Exploitation et entretien - ligne	1,84	1,59	1,30
- réseau	3,84	3,19	2,60
Coûts de l'énergie	14,28	11,00	8,68
Total	51,92	49,15	47,01
Centrales hydro-électriques locales			
Frais fixes - centrales hydro-électriques	57,12	64,15	68,05
- réseau de distribution	18,13	18,52	18,82
Exploitation et entretien - ligne	10,59	2,58	6,76
- réseau	3,07	2,58	2,10
Total	88,91	94,03	95,73
Centrales thermiques locales - biomasse			
Frais fixes - centrale	45,15	44,07	42,83
- réseau de distribution	18,13	18,52	18,82
Exploitation et entretien - centrale	23,75	18,50	14,74
- réseau	3,07	2,58	2,10
- variables	1,99	1,53	1,21
Coûts du combustible	61,29	47,22	37,24
Total	153,38	132,42	116,94
Centrales thermiques locales - diesel			
Frais fixes - centrale	20,56	19,52	18,58
- réseau de distribution	18,13	18,52	18,82
Exploitation et entretien - centrale	12,35	9,62	7,66
- réseau	3,07	2,58	2,10
- variables	8,25	6,36	5,02
Coûts du combustible	55,93	43,09	22,99
Total	118,29	99,69	86,17

Remarque: Les données précédentes sur la valeur actualisée sont fournies uniquement pour fin de comparaison et ne peuvent servir à calculer le prix de l'énergie pour le consommateur.

Les deux premiers modes d'approvisionnement en énergie ont fait l'objet d'une évaluation préliminaire en vue de déterminer les répercussions sur le milieu. Le projet de raccordement au système central se répercuterait principalement sur les activités de piégeage. L'installation de la ligne de transport au cours des mois d'hiver pourrait effaroucher la faune vivant dans l'emprise et la faire fuir ailleurs, ce qui entraînerait une diminution provisoire du nombre de peaux levées. Il se pourrait que les trappeurs demandent d'être indemnisés; toutefois, les effets seraient provisoires. Un effet possible à long terme serait un accroissement de la chasse des ongulés le long de l'emprise. La construction de centrales hydro-électriques locales produirait aussi ces deux types d'effets. Les conséquences les plus graves de la construction de centrales hydro-électriques à échelle réduite seraient la destruction de l'habitat principal de la truite de ruisseau et la création d'obstacles à la migration des poissons dans la région du Gods Lake. Il y aurait diminution des stocks de truite de ruisseau et le chiffre d'affaires de certains camps de pêche, qui dépendent de cette espèce pour attirer leurs clients, pourrait fléchir.

D'après une évaluation préliminaire, des dimensions socio-économiques, les deux modes d'approvisionnement en énergie produiraient des effets semblables. L'amélioration du système électrique dans les collectivités du Centre-nord de la province créerait des emplois temporaires et des possibilités de revenue pour les résidents locaux intéressés. La réfection des routes pourrait s'avérer nécessaire et cela serait avantageux à long terme pour les collectivités. Toutefois, les résidents qui choisissent d'améliorer les services qu'ils obtiennent serait obligés de supporter la hausse continue des coûts en raison de leur consommation accrue d'électricité, qu'elle serve ou non au chauffage. L'importance de cette hausse dépendrait des avantages qu'ils voient dans un meilleur approvisionnement en électricité.

Les résidents des collectivités ont été informés des résultats de cette étude afin qu'ils puissent en discuter et formuler leurs points de vue. Ils ont choisi presque unanimement le mode d'approvisionnement recommandé, soit le raccordement au réseau central de la Manitoba Hydro près de Kelsey. En outre, les résidents de certaines collectivités ont complètement rejeté la possibilité des centrales hydro-électriques locales en raison de l'incidence qu'elles peuvent avoir sur les ressources naturelles de la région.

Bref, compte tenu des dimensions économiques, écologiques, sociales et publiques, le raccordement au réseau central de la Manitoba Hydro à Kelsey a été jugé la source préférée d'approvisionnement illimité en énergie électrique pour les collectivités situées au Centre-nord de la province.

Cette étude a été effectuée par I.D. Engineering Company, Montreal Engineering Company Ltd. et Teshmont Consultants Inc. pour le Island Lake Tribal Council à l'aide d'une subvention des Affaires indiennes et du Nord Canada et du Programme de démonstration dans les collectivités éloignées d'Energie, Mines et Ressources Canada.

1. INTRODUCTION

The study area consists of seven separate and distinct communities located east of Lake Winnipeg and about 525 kilometres (line of flight distance) northeast of the City of Winnipeg. The communities included in this study are:

Garden Hill
Gods Lake Narrows
Gods River
Oxford House
Red Sucker Lake
St. Theresa Point
Waasagomach

These communities consist of approximately 97 percent Treaty and 3 percent non-Treaty residents.

At present electrical energy is provided in the communities by local independent distribution systems from diesel generation plants. Residential services in the communities are restricted to a maximum 15 amp capacity, with corresponding restrictions on the normal general service customers.

Based on the federal Department of Energy, Mines and Resources interest in reducing Canada's dependence on oil, the Remote Community Demonstration Program (RCDP) was instituted under the overall government off-oil initiative aimed at power generation and space heating at the community level. The Island Lake Tribal Council including the Chiefs of the communities of Oxford House, Gods Lake Narrows, and Gods River formed a Management

Committee and applied for funds under Phase I of the RCDP in order to carry out a study to investigate the alternative feasible energy supply options which are available to the communities. As a result, the Federal Departments of Energy, Mines and Resources and of Indian Affairs and Northern Development agreed to jointly fund the North Central Electrification Study.

Due to the growing concern with and the complete unacceptability of restricted electrical service in the communities, the Island Lake Tribal Council commissioned this study. The objective of the study was to gather all information available and the results of previous studies which had been carried out with regard to the supply of unrestricted electric service to the seven communities, herein referred to as the North Central communities (see Figure 1-1). Previous studies were to be examined in order to identify any information gaps which may exist and to eliminate any such gaps. Also included in the objectives of the study was the need to prepare population, electrical energy demand and load projections for the communities; review and analyse the various feasible alternatives available for the provision of unrestricted electric service to the communities and compare the costs of such alternatives, including costs to the householders for the upgrading of household wiring which might be required and any costs for the upgrading of general distribution within the communities. In reviewing the alternative supply systems available, alternative electrical generation systems were to be examined including solar, wind, and biomass. Finally, in examining the various alternatives, the potential environmental impact of construction and operation of the various systems on the area and socio-economic impact of both construction and operation of the recommended system as well as the im-

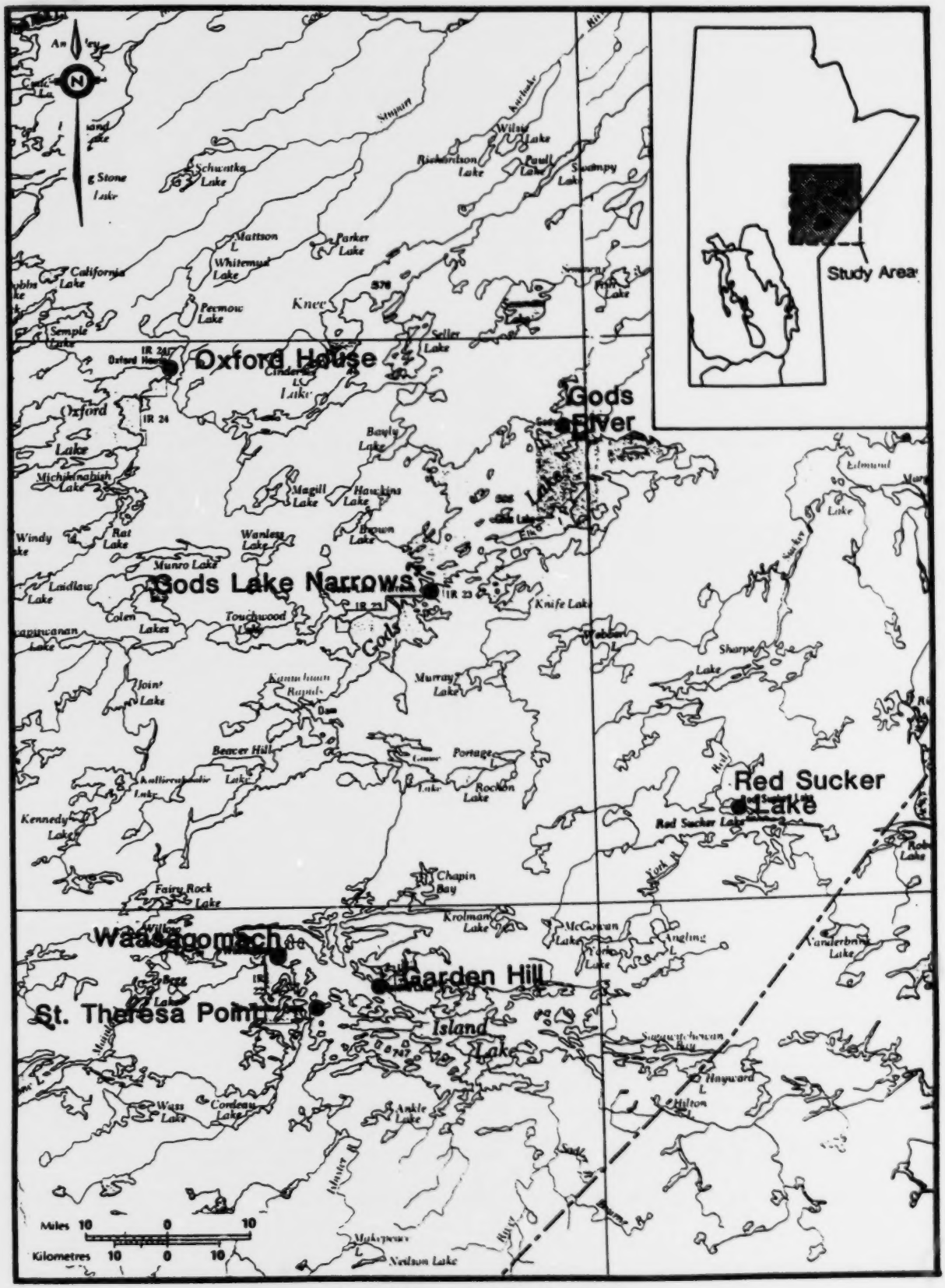

Figure 1-1 Map of Study Area

pact of the availability of unrestricted electrical energy on the communities were to be assessed.

The time period which was used for population and load projections and cost evaluations extended to the year 2015, and it has been assumed that all the communities would have unrestricted service available by the 1988-89 fiscal year of Manitoba Hydro.

Manitoba Hydro has over the past five years reviewed the problem of servicing the area and the communities on several occasions and has issued reports and updated these reports from time to time to keep information as current as possible. As a result of the foregoing and because of limitations of time and budget, a detailed analysis and costing of continued generation of diesel electric power and the provision of restricted service was not carried out. Manitoba Hydro current figures and projections were utilized. The projections for the continued provision of restricted, diesel generated service are shown in Figures 1-2 and 1-3.

The routings and locations of facilities utilized in the study, were based on an examination of existing mapping and aerial photography and as such are preliminary. The unit costs utilized to estimate capital costs are the latest costs available, and the construction cost estimates include the engineering and construction supervision cost. The seven local generation sites considered and reported on were visited and visually inspected. No other field investigations were carried out with regard to these sites, nor were field trips made along the proposed transmission line route between

ISLAND LAKE AREA ENERGY FORCAST 1980/81 TO 2015/16
GARDEN HILL ,3.00 PCT POP. GROWTH, 7.10 TO 5.7 PRS PER HOUSE
PLUS:GODS LAKE NARROWS ,3.00 PCT POP. GROWTH,6.986-5.7 PRS PER HOUSE
PLUS:GODS RIVER ,3.00 PCT POP. GROWTH, 6.410 TO 5.7 PRS PER HOUSE
PLUS:OXFORD HOUSE ,3.00 PCT POP. GROWTH, 5.757 TO 5.7 PRS PER HOUSE
PLUS:RED SUCKER LAKE ,3.00 PCT POP. GROWTH, 7.320 TO 5.7 PRS PER HOUSE
PLUS:ST THERESA POINT ,3.00 PCT POP. GROWTH, 8.391 TO 5.7 PRS PER HOUSE
PLUS:WASSAGAMACH ,3.00 PCT POP. GROWTH, 7.488 TO 5.7 PRS PER HOUSE

ISOLATED DEISEL SUPPLY

TABLE 1A

BASE YEAR 1980 (38)

YEAR	MWH TOTAL HOUSE CONSUMP'N	FED. LIGHTING LOAD MWH	PROV. LIGHTING LOAD MWH	OTHER LIGHTING LOAD MWH	MWH ESTIMATED ST LIGHT CONSUMP'N	MWH TOTAL C + H + S CONSUMP'N
1980	4643	4045	425	1276	172	10560
1981	4798	4146	435	1307	199	10885
1982	5423	4285	450	1352	226	11736
1983	5194	4383	460	1393	213	11636
1984	5440	4484	472	1414	227	12037
1985	5696	4587	482	1446	236	12448
1986	5966	4695	493	1479	249	12882
1987	6248	4802	505	1515	261	13329
1988	6538	4912	516	1548	275	13789
1989	6854	5025	529	1584	290	14282
1990	7180	5142	540	1620	303	14786
1991	7523	5258	552	1658	318	15311
1992	7748	5380	566	1697	330	15719
1993	7977	5504	578	1735	337	16131
1994	8217	5631	591	1776	348	16563
1995	8461	5758	605	1815	358	17000
1996	8716	5892	619	1857	369	17454
1997	8984	6028	633	1900	380	17927
1998	9246	6166	647	1944	392	18395
1999	9530	6308	665	1989	405	18896
2000	9804	6454	679	2036	414	19385
2001	10108	6600	695	2081	428	19914
2002	10412	6753	710	2130	442	20447
2003	10722	6909	727	2179	456	20991
2004	11052	7067	743	2228	468	21552
2005	11366	7230	760	2280	482	22119
2006	11711	7396	778	2333	497	22714
2007	12070	7567	796	2386	510	23328
2008	12435	7740	812	2442	526	23957
2009	12804	7919	833	2497	542	24594
2010	13184	8100	850	2553	559	25249
2011	13586	8286	870	2614	575	25931
2012	13986	8478	890	2673	593	26621
2013	14410	8673	912	2735	611	27340
2014	14836	8872	933	2798	630	28069
2015	15290	9076	954	2862	648	28830

STUDY:ISLKX23; CALC:DIESEL; TBL:D1A; CASES: GHILL GLN GRIV OXH RSL STP WAS

Figure 1-2

ISLAND LAKE AREA ENERGY FORCAST 1980/81 TO 2015/16
GARDEN HILL ,3.00 PCT POP. GROWTH, 7.10 TO 5.7 PRS PER HOUSE
PLUS:GODS LAKE NARROWS ,3.00 PCT POP. GROWTH,6.986-5.7 PRS PER HOUSE
PLUS:GODS RIVER ,3.00 PCT POP. GROWTH, 6.410 TO 5.7 PRS PER HOUSE
PLUS:OXFORD HOUSE ,3.00 PCT POP. GROWTH, 5.757 TO 5.7 PRS PER HOUSE
PLUS:RED SUCKER LAKE ,3.00 PCT POP. GROWTH, 7.320 TO 5.7 PRS PER HOUSE
PLUS:ST THERESA POINT ,3.00 PCT POP. GROWTH, 8.391 TO 5.7 PRS PER HOUSE
PLUS:WASSAGAMACK ,3.00 PCT POP. GROWTH, 7.488 TO 5.7 PRS PER HOUSE
ISOLATED DIESEL SUPPLY
TABLE 1
BASE YEAR 1980

YEAR	ESTIMATED TOTAL'N	REQ'D HOUSES	OLD HOUSES	HVH CONSUMP'N OLD HOUSES	NEW HOUSES	HVH CONSUMP'N NEW HOUSES	HVH TOTAL HOUSE CONSUMP'N	HVH ESTIMATED COMMER'L CONSUMP'N	HVH TOTAL COMMER'L + HOUSES	ESTIMATED NO. OF ST LIGHTS	HVH ESTIMATED ST LIGHT CONSUMP'N	HVH TOTAL C + H + S CONSUMP'N	PEAK DEMAND KW
1980	6204	893	893	4643	0	0	4643	5745	10388	234	172	10560	2411
1981	6390	963	893	4457	70	341	4798	5888	10686	269	199	10885	2485
1982	6581	997	893	4881	104	542	5423	6087	11510	307	226	11736	2680
1983	6779	1043	893	4452	150	742	5194	6229	11423	292	213	11636	2657
1984	6982	1092	893	4452	199	988	5440	6370	11810	308	227	12037	2748
1985	7193	1143	893	4452	250	1244	5696	6516	12212	322	236	12448	2841
1986	7408	1197	893	4452	304	1514	5966	6667	12633	339	249	12882	2941
1987	7630	1253	893	4452	360	1796	6248	6820	13068	356	261	13329	3044
1988	7860	1311	893	4452	418	2086	6538	6976	13514	374	275	13789	3149
1989	8094	1374	893	4452	481	2402	6854	7138	13992	394	290	14282	3261
1990	8338	1439	893	4452	546	2720	7180	7303	14483	413	303	14786	3376
1991	8588	1507	893	4452	614	3071	7523	7470	14993	433	318	15311	3496
1992	8844	1552	893	4452	659	3296	7748	7641	15389	447	330	15719	3588
1993	9110	1598	893	4452	705	3525	7977	7817	15794	459	337	16131	3683
1994	9384	1646	893	4452	753	3765	8217	7998	16215	474	348	16563	3781
1995	9667	1695	893	4452	802	4009	8461	8181	16642	488	358	17000	3881
1996	9955	1746	893	4452	853	4264	8716	8369	17085	503	369	17454	3985
1997	10255	1800	893	4452	907	4532	8984	8563	17547	517	380	17927	4094
1998	10562	1852	893	4452	959	4794	9246	8757	18003	533	392	18395	4199
1999	10878	1909	893	4452	1016	5078	9530	8961	18491	550	405	18896	4315
2000	11205	1964	893	4452	1071	5352	9804	9167	18971	565	414	19385	4426
2001	11541	2025	893	4452	1132	5656	10108	9378	19486	583	428	19914	4546
2002	11888	2086	893	4452	1193	5960	10412	9593	20005	600	442	20447	4668
2003	12245	2148	893	4452	1255	6270	10722	9813	20535	619	456	20991	4791
2004	12612	2214	893	4452	1321	6600	11052	10038	21090	638	468	21558	4922
2005	12990	2277	893	4452	1384	6914	11366	10271	21637	655	482	22119	5052
2006	13378	2346	893	4452	1453	7259	11711	10506	22217	675	497	22714	5186
2007	13781	2418	893	4452	1525	7618	12070	10748	22818	695	510	23328	5325
2008	14195	2491	893	4452	1598	7983	12435	10996	23431	717	526	23957	5468
2009	14621	2565	893	4452	1672	8352	12804	11248	24052	738	542	24594	5615
2010	15058	2641	893	4452	1748	8732	13184	11506	24690	760	559	25249	5764
2011	15512	2722	893	4452	1829	9134	13586	11770	25356	783	575	25931	5921
2012	15976	2802	893	4452	1909	9534	13986	12042	26028	806	593	26621	6077
2013	16456	2887	893	4452	1994	9958	14410	12319	26729	830	611	27340	6243
2014	16949	2972	893	4452	2079	10384	14836	12603	27439	857	630	28069	6409
2015	17457	3063	893	4452	2170	10838	15290	12892	28182	881	648	28830	6583

STUDY:ISLKA2R; CALC:DIESEL; TBL:01; CASES: GHILL GLN GRIV OXH RSL STP WAS

Figure 1-3

Kelsey and Oxford House, nor the routing of the grid legs interconnecting the communities.

This report is structured to respond in a logical manner to the above mandate. Chapter 2 derives the electric load forecast for the North Central communities over the period of the study which has been taken to be 1980 to the year 2015. Chapter 3 discusses the effect on each community of the access to the unrestricted electrical energy service, including costs to the householder. Chapters 4, 5, and 6 present descriptions of the supply alternatives and include an estimate of their capital and operating costs. The main alternatives considered are supply from the Manitoba Hydro Central Grid, the construction and operation of several isolated local hydroelectric plants, and the construction of wood-fired or diesel thermal plants, all of which could be installed to meet the load forecast. In Chapter 7, the economics of these alternatives are compared. Chapter 8 discusses the socio-economic impacts of the alternative found to be most attractive. Chapter 9 presents the environmental impacts of the primary alternatives, and Chapter 10 presents the reactions of the members of each of the communities to the alternatives considered and the results of the analyses. The report ends with a summary of the conclusions reached in the study.

2. POPULATION, HOUSEHOLD SIZE, AND LOAD PROJECTIONS

2.1 Population

A review was conducted of Manitoba Hydro's population projections for the seven case communities as contained in the report "Island Lake Energy Forecast Vol. II Appendices " dated August 3, 1983. This review entailed a comparison of Hydro's various projections with other documented projections, a review of existing data on Manitoba Indian population trends, and calculation of an independent projection.

Manitoba Hydro (April 3, 1983:22) drew two population growth projections for the seven northeast Manitoba communities from actual 1975-1982 population data. The base information from that study is reproduced below. "Federal Jurisdiction" refers to the community populations on-reserve, "Provincial Jurisdiction" refers to the community populations not on the reserves.

	Federal Jurisdiction	Provincial Jurisdiction	Total
1975	4979	-	-
1976	5203	-	-
1977	5304	-	-
1978	5499	317	5816
1979	5687	-	-
1980	5887	-	-
1981	-	-	-
1982	-	272	-

From this data Hydro calculated straight trend line projections for each jurisdiction, +3.4%/year for the on-reserve population and -3.8%/year for the

community population not on the reserves. Manitoba Hydro then derived a weighted growth rate for the combined jurisdictions of +3.0%/year. The +3.0%/year growth rate and a stepped 3.0-2.0-1.0%/year population growth rate were then used by Manitoba Hydro to project total and community-specific populations and as a result, the electrical load growth from 1980 through 2015.

Two other documented population projections were reviewed. One which had been done by the Department of Renewable Resources and Transportation Services (February, 1978:73-74) covered the communities of Garden Hill, Red Sucker Lake, St. Theresa Point, and Waasagomach. This study projected an aggregate annual growth rate of 3.7% for the period 1980-1990. However, the projections were based on only two actual totals (1971 and 1977) which enclosed a period of very high birthrates (upwards of 16.3 births per 100 females age 15-44; Signer and Locatelli, 1980:3-4) and generally high population growth for Manitoba Registered Indians (3.1%/year; Signer and Locatelli, 1978:2-3). Finally, the Renewable Resources projections do not take into account the other three northeast communities. We conclude that the 3.7% growth rate projection is too high.

Unies Ltd. (1983) presented only actual 1978 and 1983 data for the seven communities. Unies found an actual growth rate of 2.2%/yr. for this period in comparison to Renewable Resources' actual 3.7%/yr., and Manitoba Hydro's trend projections of 3.0%/yr. and 3.0-2.0-1.0%/yr.

An independent projection of the total area population (Table 2-1) to the year 2001 was carried out and was based on the actual 1971, 1976, and

(Continued on page 14)

Age Cohort	1971[1,2] Total Banks	1971[1,2] % in City.	1971[1,2] In City.-Band	1971[1,2] Deaths/100	1971[1,2] Deaths	1976[1,2] Total Banks	1976[1,2] % in City.	1976[1,2] In City.-Band	1976[1,2] Deaths/100	1976[1,2] Deaths	1981[1,2] Total Banks	1981[1,2] % in City.	1981[1,2] In City.-Band	1981[1,2] In City.-All[3]	1981[1,2] Deaths/100[4]	1981[1,2] Deaths	1986[1] Total-All[3]	1986[1] % in City.[6]	1986[1] In City.-All	1986[1] Deaths/100[4]	1986[1] Deaths	1991[1] Total-All	1991[1] % in City.[6]	1991[1] In City.-All	1991[1] Deaths/100[4]	1991[1] Deaths	1996[1] Total-All	1996[1] % in City.[6]	1996[1] In City.-All	1996[1] Deaths/100[4]	1996[1] Deaths	End of 2001 Total-All	End of 2001 In City. Deaths	End of 2001 In City.-All	Annual Growth Rate (%) 1981-2001
0- 4[7]	906	91.5	829	0	0	919	91.8	844	0	0	972	91.8	892	929	.0	0	1714	92.0	1576	0	0	1969	92.2	1815	0	0	2153	92.3	1987	0	0	2153	0	1987	2.40
5- 9	850	90.1	766	1.2	10	977	88.2	862	0	0	1067	88.8	947	979	0	0	1012	87.7	888	0	0	1714	87.1	1493	0	0	1969	86.4	1702	0	0	1969	0	1782	
10-14	686	92.6	636	2.5	17	840	89.5	752	1.4	12	990	87.6	867	894	1.6	16	1101	84.9	935	1.4	15	1012	82.4	834	1.1	11	1714	79.9	1369	0.9	15	1699	12	1357	
15-19	518	94.8	491	1.9	8	669	94.3	631	1.9	13	828	90.2	747	775	1.9	12	1005	88.5	889	1.0	10	1086	86.2	936	0.7	8	1001	83.9	840	0.5	5	996	4	836	
20-24	416	88.9	370	3.8	16	510	88.6	452	2.0	1	656	92.1	604	641	2.6	17	845	93.0	786	2.3	19	995	94.7	942	2.1	21	1078	96.3	1038	1.8	19	1059	19	1019	
25-29	350	81.1	284	2.8	7	401	82.5	331	5.5	22	509	84.7	431	465	3.6	18	679	86.4	587	3.4	23	826	88.2	729	3.1	26	974	90.0	877	2.9	28	946	25	852	2.49
30-34	283	82.0	232	2.8	8	343	78.9	274	2.3	8	379	81.3	308	332	2.3	9	531	80.0	425	2.0	11	656	79.7	523	1.8	12	800	79.3	634	1.5	12	788	10	624	
35-39	191	89.0	170	1.6	3	275	84.0	231	3.3	9	335	79.0	264	282	2.4	8	399	74.0	295	2.1	18	520	69.0	359	1.9	10	644	64.0	412	1.6	10	634	7	409	
40-44	154	89.6	138	2.6	4	188	88.8	167	2.7	5	266	83.5	222	234	2.4	6	350	81.2	284	2.2	8	391	78.2	306	1.9	7	510	75.1	383	1.7	9	501	7	376	
45-49	148	95.9	142	1.4	2	150	87.3	131	4.7	7	183	90.2	165	171	2.8	5	274	85.4	234	2.6	7	342	82.6	282	2.5	8	384	79.7	306	2.1	8	376	6	300	2.09
50-54	112	95.5	107	0.9	1	146	89.0	130	2.7	4	143	86.0	123	136	1.7	2	185	80.7	149	1.4	3	267	75.9	203	1.2	3	334	71.2	169	0.9	3	331	2	167	
55-59	91	95.6	87	3.2	3	111	92.8	103	3.6	4	142	89.4	127	133	3.2	5	149	86.4	129	2.9	4	182	83.3	152	2.7	5	264	80.2	212	2.4	6	258	5	207	
60-64	81	97.5	79	4.9	4	87	98.8	86	5.7	5	107	94.4	101	101	5.1	5	144	93.8	135	4.8	7	145	92.3	134	4.8	7	177	90.7	161	5.3	9	168	9	152	
65-69	72	97.2	70	9.7	7	77	98.7	76	15.6	12	82	97.6	80	81	12.5	10	102	98.2	100	12.3	13	137	98.4	135	12.0	16	138	98.6	136	11.8	16	122	16	120	
70-74	51	100.0	51	13.7	7	69	90.8	59	21.5	14	65	95.4	62	64	17.8	12	73	90.8	66	17.6	13	89	88.5	79	17.3	15	121	86.2	104	17.1	21	100	18	86	
75-79	21	100.0	21	28.6	6	44	97.7	43	20.5	9	51	98.0	50	52	22.9	12	55	96.6	53	22.6	12	60	99.6	57	22.4	13	74	94.6	70	22.1	16	58	19	55	0.94
80-84	16	100.0	16	18.8	3	15	100.0	15	13.3	2	35	97.1	34	35	15.9	6	41	96.1	39	15.6	6	43	94.7	41	15.4	7	47	93.2	44	15.1	7	40	7	37	
85-89	11	90.9	10	100.0	11	13	100.0	13	100.0	13	13	100.0	13	13	99.8	13	30	100.0	30	99.5	30	35	100.0	35	99.2	35	36	100.0	36	99.0	36	0	36	0	
90-94	2	100.0	2	100.0	2	0	-	0	-	0	0	-	0	0	99.8	0	0	100.0	0	99.5	0	0	100.0	0	99.2	0	0	100.0	0	99.0	0	0	0	0	
95-99	1	100.0	1	100.0	1	0	-	0	-	0	0	-	0	0	99.8	0	0	100.0	0	99.5	0	0	100.0	0	99.2	0	0	100.0	0	99.0	0	0	0	0	
Not Stated	0	-	0	-	0	0	-	0	-	0	0	-	0	2[8]	0	0	0	-	0	-	0	0	-	0	-	0	0	-	0	-	0	0	0	0	
	4960	91.2	4522	2.4	120	5850	89.2	5198	2.4	140	6823	88.5	6037	6309	2.3	156	8669	87.5	7600	1.8	159	10469	86.4	9055	1.9	204	12418	84.6	10480	1.8	220	12196	198	10282	2.35
Actual Births:			977[7]					1067[7]					1012[7]						1714					1969					2153							
Birth Rate[9]:			1.03 (946F, 49.4%)					0.89 (1199F, 50.2%)					0.93 (1469F, 49.4%)						0.90 (1904F, 50%)					0.88 (2237F, 50%)					0.86 (2504F, 50%)							

Table 2-1: North Central Electrification Study - Aggregate Population Projections

Table 2-1 Notes:

1. Deaths for 1971, 1976, 1981, 1991, and 1996 are five-year totals.

2. 1971, 1976, and 1981 Band data, except for 1981 births and deaths, is actual Band data supplied by Indian Affairs.

3. The "In Community-All" column shows the total Band plus non-Treaty population living in the community. Non-Treaty population is derived by estimating the 1981 populations of Oxford House, St. Theresa Point, Gods Lake Narrows, Red Sucker Lake, and Stevenson Island - see Manitoba Dept. of Northern Affairs 1982 Census of Remote Northern Communities, June 1982.

4. Death rates for 1981, 1986, 1991, and 1996 are computed by calculating the age-cohort specific weighted average 1971 and 1976 death rate, and reducing the weighted average death rate by 0.25 for each following five-year period. The DIAND publication An Overview of Demographic, Social, and Economic Conditions Among Manitoba's Registered Indian Population, December 1980, shows Treaty Indian death rates falling by 0.05 per 100 per year during the 1974-1976 period. Forecasts of future death rates are not available.

5. The "Total-All" refers to the total original Band plus non-Treaty population living within and outside the communities. It is assumed that the proportion of the non-Treaty population living outside the communi-

ties is the same as the proportion of the Treaty population living outside the community. Consequently, the non-Treaty in-community population is inflated by a factor of 1/[the percentage of band members in the communities] in each age cohort.

6. The 1986, 1991, and 1996 "% in Community" are found by linear regression from 1971, 1976, and 1981 age-cohort actuals. It was assumed that estimates of migration for Manitoba Treaty Indians as a whole are not applicable the subject-area communities because of remoteness (see An Overview of Demographic, Social, and Economic Conditions...).

7. As a result of data collection by Indian Affairs the following 5-9 age-cohort is always larger than the preceeding 0-4 age cohort. In order to reconcile the data it is assumed that the actual number of births in the preceeding 0-4 age cohort is equal to the following 5-9 age cohort population, and it is assumed that the 0-4 age death rate is 0.

8. "Not stated" according to the 1982 Census of Remote Northern Communities. This number is shown for information only, it does not enter any calculations.

9. The birth rate for 1971 and 1976 is determined by dividing the "actual births" by the number of females age 15-44. In 1971 and 1976 females made up 49.4% and 50.2% of the 15-44 population, respectively. It is assumed that females will make up 50% of the 15-44 population in 1986, 1991, and 1996. The weighted average birth rate for 1971 and 1976 is

0.95. This birth rate is reduced by 0.0235 for each five years following 1976. It is assumed that the birth rate will fall equivalent to the falling birthrate forecast (1976-1986) in An Overview of Demographic, Social, and Economic Conditions.

1981 populations, and on the 1971-1975 and 1976-1981 birth, migration, and death rates. In this projection we have used the following assumptions:

- o The actual age-cohort specific death rates would decline by 0.25 per 100 during each five-year period 1981-2001, similar to the expectation for all Manitoba Treaty Indians.
- o The proportion of the original non-Treaty population living outside the communities is the same as the proportion of the Treaty population living outside the communities, and that this equivalency will continue to the year 2001.
- o The age-specific percent of the original population living outside the communities will follow a trend line based on the age-specific percent of the Treaty population living outside of the communities in 1971, 1976, and 1981.
- o Females will continue to make-up 50% of the age 15-44 population to the year 2001.
- o The weighted average birth rate for the periods 1971-1975 and 1976-1980 will fall by 0.0235 per female age 15-44, similar to the expectation for all Manitoba Treaty females age 15-44.

Using the above assumptions and aging the age-cohort specific populations a predicted annual growth rate of 2.35%/year for the period 1981-2001 was generated. Given an actual aggregate population of 6,309 in 1981, a 2.35%/yr. growth rate gives a total population of 10,282 at the end of 2001. In comparison:

- o Manitoba Hydro's 3.0%/year growth rate would generate a population of 11,737 at the end of 2001, or 1,455 more (14.2% more). (Hydro's actual projected total for 2001, because a different base is used, is 11,541 or 1,259 more (12.2% more)).
- o Manitoba Hydro's stepped 3.0%/year for the period 1980-1983, 2%/year for the period 1984-1992, and 1.0%/yr. for the period 1992-2001 would generate 9,101 at the end of 2001, or 1,181 less (11% less). (Hydro's actual projected total for 2001, because a different base is used, is 9,824 or 458 less (4.5% less)).
- o A 2%/year growth rate would generate 9,562 at the end of 2001, or 720 less (7.0% less).

In conclusion, the prediction is that the aggregate annual population growth for the period 1981 to 2015 will be 2.35% per annum. For information purposes the populations of the individual communities were projected based on an assumed aggregate population growth of 2.35%/year and on the assumption that each community will also grow at this annual rate (see Table 2-2).

2.2 Household Size

While population growth projections impact on energy demand and peak demand, another factor contributing to the increase or otherwise of electrical energy demand is average household size (i.e. persons per house). This is due to the fact that households and not necessarily individuals become Hydro customers. As such an increase in the number of households even with a constant population also increases the electric energy demand in a community. Conversely increasing the number of people in the community with no corresponding increase in the number of households may not drastically effect consumption and demand.

The number of persons per house is dependent on population, age of the population, and the availability of housing. Based on the projection of an average annual increase in population of 2.35%, the total population in the year 2001 would be 10,282. If no households were added to the communities then the average number of people per household could increase from the 1982 weighted average of 5.7 to 9.1 persons per house. However, it is reasonable to assume that future federal and provincial housing programs for the

Community/Age-Group	1981[1]	1986[2]	1991[2]	1996[1]	End of 2001[2]
Garden Hill-Stevenson Island					
0-19	966	1158	1371	1592	1587
20-44	543	660	794	929	910
45-64	150	181	216	238	232
65+	59	69	83	93	71
Total	1718	2068	2464	2852	2800
Gods Lake					
0-19	572	686	812	943	940
20-44	316	384	462	541	530
45-64	82	99	118	130	127
65+	45	53	64	72	55
Total	1015	1222	1456	1686	1652
Gods River					
0-19	154	185	219	254	246
20-44	64	78	94	110	108
45-64	25	30	36	40	39
65+	8	9	11	12	9
Total	251	302	360	416	402
Oxford House					
0-19	564	676	800	929	926
20-44	296	360	433	507	497
45-64	106	128	153	168	164
65+	59	69	83	93	71
Total	1025	1233	1469	1697	1658
Red Sucker Lake					
0-19	197	236	279	324	323
20-44	120	146	176	206	202
45-64	34	41	49	54	53
65+	15	18	22	25	19
Total	366	441	526	609	597
St. Theresa Point					
0-19	728	873	1034	1200	1196
20-44	433	527	634	742	727
45-64	96	116	138	152	148
65+	41	48	58	65	50
Total	1298	1864	1864	2159	2121
Waasagomach					
0-19	394	472	559	649	647
20-44	182	221	266	311	305
45-64	43	52	62	68	66
65+	18	21	25	28	21
Total	655	766	912	1056	1039

Table 2-2: North Central Electrification Study - Community Population Projections

Table 2-2 Notes:

1. From Indian Affairs actual data and Manitoba Dept. of Northern Affairs 1982 Census of Remote Northern Communities, June 1982.

2. Five year projections equivalent to five year age-group projection factors implicit in Table 2-1. Assumes that the growth of each age-cohort in each community will be equivalent to the aggregate age-cohort growth in Table 2-1.

Age Group	Age Group Growth Factors			
	1981 to 1986	1986 to 1991	1991 to 1996	1996 to End of 2001
0-19	0.199	0.184	0.161	(0.003)
20-44	0.216	0.203	0.171	(0.020)
45-64	0.209	1.192	0.100	(0.026)
65+	0.176	0.205	0.124	(0.236)

3. End of 2001 age-group populations are less than 1996 populations. End of 2001 decreases are due to the allocation of all births to beginning of five-year period (End of 2001).

communities will increase housing availability rather than merely replace deteriorated existing housing.

According to the Department of Indian Affairs (Korpesho, personal communication) generally the number of new houses constructed on northern reserves has to the present time barely kept pace with the deterioration of existing houses. To assume that this situation will continue to exist or deteriorate is not reasonable. Recently, however, additional financing through the Department of Indian Affairs has enabled Bands to construct larger and better quality houses in the communities. The larger sized houses may encourage continued large, and perhaps even larger, household sizes. However, if the number of housing units constructed per year remains constant, better quality housing should also enable the Department to gradually reduce the average household size. The longer structural lifespan of new housing will enable the Department to reduce the backlog of required housing.

Furthermore on examining the household makeup in nine other northern communities, all of which are connected to the Manitoba Hydro Central System (see Table 2-3), the average household size other than that of Nelson House, where the average occupancy is almost twice that of other communities, is considerably lower than the weighted average of 5.7 for the seven communities considered in this study. In examining the statistics it is concluded that the most realistic figure for the number of people per household would be 5.43. This figure is derived by excluding the community of Nelson House from the average as well as eliminating the additional housing made available in the communities of Cross Lake and Norway House as a result of moneys

COMPARATIVE PERSONS PER HOUSE DATA FOR
NINE NORTHERN MANITOBA RESERVES WITH
CENTRAL SYSTEM LANDLINE HYDRO TIE

Reserve	Population as of June 1982[a]	No. of Houses Prior to 1983[a]	Houses Const. in 1983[b]	Total Houses at End of 1983	Persons Per House	Landline Hydro	All-Weather Road
1. Chemawawin	419	89	4	93	4.51	Yes	Yes
2. Cross Lake	2044	382	34 + (10)[c]	416 (426)	4.91 (4.80)	Yes	Yes
3. Grand Rapids	285	60	7	67	4.25	Yes	Yes
4. Hollow Water	391	98	7	105	3.72	Yes	Yes
5. Moose Lake	309	56	2	58	5.33	Yes	Yes
6. Nelson House	1981	189	17	206	9.62	Yes	Yes
7. Norway House	2369	461	22 + (16)[d]	483 (499)	4.90 (4.75)	Yes	Yes
8. Split Lake	1061	178	13	199	5.33	Yes	Recent
9. York Landing	313	56	5	61	5.13	Yes	No
10. Totals							
i) With #2 & #7 Additional[e]	9172	1569	(137)	(1714)	(5.17)		
ii) Without #2 & #7 Additional[f]	9172	1569	111	1688	5.43		
iii) With #2 & #7 Additional But Without #6[g]	7191	1380	(120)	(1500)	(4.79)		
iv) Without #2 & #7 Additional and Without #6[h]	7191	1380	94	1474	4.88		

a. Ratushniak, Marianne. Secretary, Community Planning Section, Local Government Program, DIAND.
b. James, Ken. Regional Housing Supervisor, Local Government Program. Diand.
c. 10 of the new houses are trailers financed through the Northern Flood Agreement.
d. 16 of the new houses are trailers financed through the Northern Flood Agreement.
e. All reserves including 26 extra houses due to Northern Flood Agreement.
f. All reserves excluding 26 extra houses due to Northern Flood Agreement.
g. All reserves except Nelson House, including 26 extra houses due to Northern Flood Agreement.
h. All reserves except Nelson Houses, excluding 26 extra houses due to Northern Flood Agreement.

TABLE 2-3

available through the Northern Flood Agreement. The figure could be further refined somewhat if the June 1982 population figures were to be increased by 2.35% (the projected average) annual population growth so as to correlate the 1983 housing figures with a projected 1983 population figure. This adjustment might increase the 5.43 average to about 5.5 people per household.

A further factor which may influence the average people per household of the communities listed in Table 2-3 is the fact that all the communities except for York Landing have all-weather road connections to the south, although the road connection to the community of Split Lake has just recently been installed (late 70's); even in this community the household average is still below the 5.43 weighted average.

It is also possible that local economic conditions in the North Central communities may improve substantially as a result of improved electrification, or as a result of other developments. If such improvements occur, higher incomes are likely to stimulate household formation and additional private house construction. However, at this time there is no evidence of a substantial improvement in local economic conditions.

In conclusion, for the purposes of projecting load growth it was assumed that the average household size, under the influence of these various trends, will reduce to and remain constant at 5.43 persons per household. If this prediction is correct, and if the aggregate population increases by 2.35%/yr., then the aggregate number of households in the study communities will increase to 1,850 by the end of 2001 and to 2557 by the end of 2015.

Manitoba Hydro in their projections assumed two possible cases of population growths, these being firstly a constant 3% per annum growth rate over the entire study period and secondly a reducing population growth of 3%-2% and 1% per annum. For the second scenario the population growth was assumed at 3% per annum up to 1982, declining to a 2% per annum growth rate by the year 1991 and a further decline from 2% to 1% between the years 1991 and 2006 and then maintaining a 1% annual growth rate till 2015. The population growth was assumed to be the same for all communities. Manitoba Hydro studies also assumed that the average number of people per household in each community would drop to the weighted average of 5.7 by 1991 and would remain at this figure till 2015. Based on the foregoing, the Manitoba Hydro projected number of houses in the communities were 2025 and 3063 respectively for the years 2001 and 2015 at a constant 3% annual population growth rate and 1725 and 2001 respectively for the years 2001 and 2015 at the declining annual growth rate of 3%, 2%, and 1%.

2.3 Existing Conditions

Restricted electric service is presently provided to the seven communities. Residential customers are provided with standard 15 amp services. Federal and Provincial Government Agencies are provided unrestricted service and under special agreements with Manitoba Hydro generally pay the full cost or less of providing electric energy. All electric energy in the North Central communities is generated by local diesel plants installed in each community with no interconnection i.e. grid between the seven systems. Generally all space heating, other than residential, in the communities is provided by

means of fuel oil with some supplementary heating with wood, propane, or kerosene. Residential heating is primarily provided by woodburning facilities.

At the end of 1983, hydro rates in effect in the communities for residential and general service customers were as follows:

a) Residential Service:

Initial 250 kilowatt hrs. per month	@ 5.47¢/kwh
All usage per month in excess of 250 kilowatt hrs.	@ 2.77¢/kwh
Monthly Service Charge	$8.75/customer

b) General Service

i) for normal commercial service

Initial 1200 kilowatt hrs. per month	@ 5.36¢/kwh
All usage per month in excess of initial 1200 kilowatt hrs.	@ 3.25¢/kwh
Monthly Service Charge	$11.00/customer

ii) Full cost rates - special agreement customers (government agencies mostly)

Location	Energy Rate (¢/kwh)	Generation Cost/Kw One time Charge
Garden Hill	23.2	$ 685
Gods Lake Narrows	23.3	565
Gods River	38.8	2,130
Oxford House	21.8	545
Red Sucker Lake	27.5	890
St. Theresa Point	23.2	1,080
Waasagomach	23.2	990

The rates charged to both residential and normal general service customers in the communities are the standard rural diesel rates applicable throughout the Province. Both these rates remain in place until the rates for the entire Province are amended. The full cost diesel rates are reviewed and amended annually, or more often, and are based on the actual costs in-

curred for operating the system, including the maintenance and replacement costs of the system, from which the service is supplied. Thus the rates for energy as well as the generation cost per kilowatt varies from community to community.

Notwithstanding the full rate charges for the supply of some of the electrical energy in the communities, all the systems in the North Central communities have incurred in the past and continue to incur large losses for Manitoba Hydro (see Table 2-4). All else being equal these losses will continue and will escalate over the next decade. The escalation in losses would be due to an increase in domestic consumption as well as general increases in the operating and maintenance cost of the thermal plants. It is interesting to note from Table 2-4 that on average the annual increase in consumption between 1975/76 and 1982/83 was 8.77% whereas the annual loss on average increased by 11.86% during the same period. Furthermore, the loss per kwh sold decreased to a low of 4.435¢ per kwh in the 1978/79 year and has increased every year since to 9.176¢ in 1982/83.

In addition to the 10,885 megawatt hours of electrical energy consumed in the communities, 2,368,000 litres of fuel oil and 23,000 litres of propane were also consumed in 1981 principally for commercial space heating. For the purposes of the study this fuel was converted to an equivalent of an annual electrical load of 16,642 megawatt hours for the year, assuming an oil and propane heating efficiency of 65% and electric heating efficiency of 100%.

HISTORIC OPERATING COSTS & INCOME
NORTH CENTRAL COMMUNITIES

	1975/76	1976/77	1977/78	1978/79	1979/80	1980/81	1981/82	1982/83
Consumption -KWh	6,438,606	7,250,532	8,023,449	9,262,649	9,887,669	10,282,225	10,639,566	11,600,814
Annual Increase in KWh Consumption (%)		12.6	10.7	15.4	6.7	4.0	3.5	9.0
Total Operating Cost ($)	1,003,756	1,046,310	1,250,806	1,357,977	1,453,695	1,676,409	2,171,085	2,679,413
Total Revenue ($)	518,089	646,144	730,885	947,219	1,008,321	1,158,313	1,351,816	1,614,931
Annual Loss ($)	485,658	400,166	519,921	410,758	445,374	518,096	819,269	1,064,482
Loss Per KWh (cents)	7.543	5.519	6.480	4.435	4.504	5.039	7.706	9.176
Cumulative Loss ($)	485,658	885,824	1,405,745	1,816,503	2,261,877	2,779,973	3,599,242	4,663,724

TABLE 2-4

2.4 Load Growth Projection

Future electrical energy requirements in the North Central communities will be influenced by many factors, a few of which are:

i) Population Growth;
ii) Number of persons living in each dwelling unit;
iii) Method of supply of electrical energy to the communities;
iv) Method of heating residences and commercial establishments;
v) Method of heating provincial, federal, and local government funded facilities;
vi) Future accessibility to and development in the area; and
vii) Consumer preferences and lifestyle changes.

The greatest single impacting factor in projecting the future electrical energy demand and thus peak demand is the assumption to be made with regard to space heating. To determine what has happened historically in northern communities that have been connected to the central system and from which restrictions on electrical use have been removed, Manitoba Hydro statistics were reviewed. In particular the change in electrical consumption patterns in the communities of Cross Lake, Nelson House, and Norway House were examined. The use patterns in these communities are as shown in Tables 2-5, 2-6, and 2-7 respectively.

For the purposes of the study and so that Manitoba Hydro statistics could more easily be utilized directly, all annual periods referred to in the load forecasts relate to Manitoba Hydro's fiscal years, i.e. April 1 of any year to March 31 of the succeeding year, unless specifically otherwise stated; as an example a reference to the 1991 year actually means the twelve month period commencing April 1, 1991 and ending March 31, 1992.

NELSON HOUSE HISTORICAL DATA RE-ELECTRICAL SERVICES AND ENERGY CONSUMPTIONS (kWh)

FISCAL YEAR	NORMAL ELECTRIC SERVICES				ALL ELECTRIC SERVICES				TOTAL	
	STANDARD RESIDENTIAL SERVICE		GENERAL PURPOSE SERVICE		STANDARD RESIDENTIAL SERVICE		GENERAL PURPOSE SERVICE			
	NO	CONSUMPTION (kWh)	NO	CONSUMPTION (kWh)	NO	CONSUMPTION (kWh)	NO	CONSUMPTION (kWh)	NO	CONSUMPTION (kWh)
1973	92	310,872	30	278,122					122	588,994
1974	104	425,810	41	698.026			2	42,130	147	1,165,966
1975	101	562,376	36	625.232	11	277,368	1	94,752	149	1,559,728
1976	119	639,611	29	733,295	15	387,797	1	41,930	164	1,802,633
1977	119	691,520	25	767,166	19	584,515	1	45,740	164	2,088,941
1978	122	721,276	27	613,357	30	748,514	7	240,670	186	2,323,817
1979	119	774,307	25	511,849	35	1,017,379	8	351,300	187	2,654,835
1980	124	852,920	26	579,262	52	1,385,580	9	394,260	211	3,212,022
1981	120	936,981	34	814,098	61	1,466,377	12	345,635	227	3,563,091
1982	128	1,048,008	31	914,122	74	1,920,500	13	437,960	246	4,320,590

1982 TOTALS FOR OTHER SERVICES

STREET LIGHTS		POWER DEMAND	
NO	CONSUMPTION (kWh)	NO	CONSUMPTION (kWh)
34	28,122	5	826,380

TABLE 2-5

NORWAY HOUSE HISTORICAL DATA RE-ELECTRICAL SERVICES
AND ENERGY CONSUMPTIONS (kWh)

FISCAL YEAR	NORMAL ELECTRIC SERVICES. STANDARD RESIDENTIAL SERVICE NO	STANDARD RESIDENTIAL SERVICE CONSUMPTION (kWh)	GENERAL PURPOSE SERVICE NO	GENERAL PURPOSE SERVICE CONSUMPTION (kWh)	ALL ELECTRIC SERVICES STANDARD RESIDENTIAL SERVICE NO	STANDARD RESIDENTIAL SERVICE CONSUMPTION (kWh)	GENERAL PURPOSE SERVICE NO	GENERAL PURPOSE SERVICE CONSUMPTION (kWh)	STREET LIGHTS NO	STREET LIGHTS CONSUMPTION (kWh)	POWER DEMAND NO	POWER DEMAND CONSUMPTION (kWh)	TOTAL NO*	TOTAL CONSUMPTION (kWh)**
1973	266	1,603,410	73	2,779,604					96	65,838			339	4,448,852
1974	282	1,980,495	69	2,784,520					98	72,550			351	4,837,565
1975	307	2,920,450	79	268,270	6	128,774	4	1,206,888	95	72,006	3	852,600	396	5,448,988
1976	322	3,190,112	72	2,116,726	22	666,540	6	852,160	108	70,840	6	2,949,240	422	9845,618
1977	319	3,327,144	70	1,814,587	49	1,118,372	11	1,015,644	109	84,535	6	3,563,770	449	10,924,052
1978	319	3,895,801	65	1,485,394	76	1,813,094	16	857,114	114	86,548	11	4,427,720	476	12,565,671
1979	312	4,531,998	60	954,828	109	2,628,587	23	987,154	135	108,275	12	5,044,904	504	14,255,746
1980	308	4,751,421	55	823,829	142	5,289,356	20	929,564	151	112,606	13	6,630,410	525	16,537,166
1981	312	4,290,584	60	867,421	192	5,846,711	28	1,020,844	192	132,232	14	7,608,410	592	17,756,202
1982	306	4,511,953	53	773,694	234	4,859,035	28	1,704,137	217	167,221	15	9,221,120	621	21,237,160

* Total Number of Customers

** Total Consumption Including Street Lights, and Power Demand

TABLE 2-6

CROSS LAKE HISTORICAL DATA RE-ELECTRICAL SERVICES
AND ENERGY CONSUMPTIONS (kWh)

FISCAL YEAR	NORMAL ELECTRIC SERVICES				ALL ELECTRIC SERVICES				STREET LIGHTS		POWER DEMAND		TOTAL	
	STANDARD RESIDENTIAL SERVICE		GENERAL PURPOSE SERVICE		STANDARD RESIDENTIAL SERVICE		GENERAL PURPOSE SERVICE							
	NO	CONSUMPTION (kWh)	NO	CONSUMPTION (kWh)	NO	CONSUMPTION (kWh)	NO	CONSUMPTION (kWh)	NO	CONSUMPTION (kWh)	NO	CONSUMPTION (kWh)	NO*	CONSUMPTION (kWh)**
1973	174	593,688	48	854,034					20	6,245			222	1,453,967
1974	229	1,012,474	47	759,525					22	18,984			276	1,770,781
1975	254	2,280,795	46	934,751					22	19,824			300	3,235,368
1976	266	2,571,660	49	775,156	15	254,505	9	303,315	23	20,203			339	3,924,839
1977	268	3,012,897	50	942,155	17	542,585	15	580,954	34	29,386			350	5,107,977
1978	282	3,403,690	55	1,029,913	34	626,764	19	634,235	37	30,415	1	146,340	390	5,871,357
1979	288	4,177,982	56	1,165,968	48	1,363,021	21	826,251	44	34,138	2	363,500	413	7,930,860
1980	286	5,173,615	41	970,647	79	1,912,341	35	1,346,594	50	38,960	4	588,260	441	10,030,417
1981	285	4,597,257	40	716,626	91	2,115,902	40	1,303,000	130	81,542	3	939,600	456	9,751,927
1982	291	4,551,542	38	745,854	110	2,482,520	41	1,430,094	163	135,804	4	965,880	480	10,289,94

* Total Number of Customers

** Total Consumption including Street Lights, and Power Demand

TABLE 2-7

As is the case with all the projections, the figures listed in the charts for the years 1980, 1981, and 1982 are actuals as determined from Manitoba Hydro records that were reviewed.

Generally as determined from existing statistics and as partly shown in Table 2-5, 2-6, and 2-7 the load growth in the communites would go through different stages. The first stage would be a very rapid escalation of demand that would occur as soon as the use restrictions are eliminated. After this rapid increase in use the average use per residential customer in the communities would approximate the average use by most non-restricted use residential consumers in the province. This would result in the average annual consumption per residential customer in the communities expanding from the existing 5500 kwh to approximately 11,500 kwh. This increase would not include full residential space heating consumption. Based on existing statistical data, this catch up period would extend over a period of seven to eight years after the restrictions are removed, i.e. unlimited electric energy becomes available. This catch up residential load growth would for this initial eight year period, average approximately 13% increase per annum. Beyond the initial eight year period the load growth in the communities due to all factors should increase by approximately the same amount as in the rest of the province, i.e. about 2 to 3% per annum.

Based on data derived from Manitoba Hydro billing runoffs, the existing commercial loads in the communities break down approximately as follows:

Federal and Local Government Load - 70.4% non heating load only
Provincial Government Load - 7.4% non heating load only
Other Commercial Load - 22.2% non heating load only

Furthermore a total of 2,368,000 litres of fuel oil and 23,000 litres of propane[1] were used in the communities in the 1981 year for the purposes of space heating. This use was made up of approximately 255,000 litres of fuel oil (10.7%) for general service customers (standard commercial service) and 2,136,000 litres of fuel oil (89.3%) and propane for federal, local, and provincial government agencies.

Of this total of 2,136,000 litres of fuel oil and propane, approximately 2,003,000 litres were utilized by federal and local government customers and 133,000 litres by provincial government customers. These amounts constituted 83.8 and 5.5% of the total fuel oil consumption in the communities.

It is reasonable to assume that due to government programs such as the off-oil program and others, as well as due to future escalation in the world price of oil, the major general service customers in the north will convert to the use of hydroelectric energy for space heating as soon as unrestricted electric service is available. It would appear that this has proven to be the case in other northern communities where unrestricted electric energy has been made available. For the purposes of load projection it was assumed that 80% of the fuel oil and propane presently being utilized by the

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[1] Unies Ltd. "Report Energy Profiles for Manitoba Remote Communities" January 1983.

general service customers for space heating would, over the initial eight year period after unlimited electric service is made available, be converted to electric heat. Based on a fuel oil heating efficiency factor of 65% and an electric heating efficiency factor of 100%, the total electric heating load (all general service customers) was estimated at 13,315 megawatt hours per year. This consumption will be over and above the non space heating loads currently being used by the general service customers (5,745 mWh, 5,888 mWh and 6087 mWh for 1980, 81 and 82 respectively).

Load Projection Assumptions and Methods

a) Case 1 Tables 2-8 to 2-8(g): (Appendix A)

i) The population, energy consumption, and peak demand of each of the seven communities were individually projected and combined in order to determine the total loads required to service the area. In all cases the consumptions, the number of houses (i.e. residential services), and the general service category breakdowns reflect existing conditions.

ii) For the alternatives based on either a central connection and/or local hydro, it was assumed that unlimited service would be available in the communities based on the following schedule.

1987	Oxford House
1988	Garden Hill and Gods Lake Narrows
1989	St. Theresa Point, Waasagomach, Gods River and Red Sucker Lake

iii) Population growth was assumed at 2.35% per annum for all communities from 1981 to 2015 based on statistics shown in Table 2-1.

iv) Number of people per house: for 1980, 81, and 82 it was assumed that number of services was equal to the number of houses, i.e. 893, 963, and 993 respectively. The target level of 5.43 people per house was established based on the data available for other northern communities as shown in Table 2-3. It was assumed that the people/house and people/service would both equal this level by the year 1991.

The average people per house for the years between 1982 and 1991 were estimated as follows:

1982	- 6.5	people/house
83	- 6.5	
84	- 6.4	
85	- 6.3	
86	- 6.2	
87	- 6.1	
88	- 6.0	
89	- 5.9	
90	- 5.8	
91 and onward	- 5.43	

v) The required houses for each year were determined by dividing the projected population for such year by the average number of people per house.

vi) The calculations of old and new houses were used to estimate the residential electric heating load. It was assumed that the 15 amp

service restriction would be lifted in the communities during the period of 1987 to 1989 and there would be no restrictions on use beyond 1989. This will result in the annual consumption per standard residential service increasing from the present annual average of approximately 5000 kWh to 11000 to 12000 kWh. For study purposes the annual residential consumption was frozen at 5000 kWh until unrestricted service is available. The load growth to saturation was based on historic data for Nelson House and Norway House.

The number of electric heat residential customers was estimated to be all those houses constructed after April 1984. Houses built up until 1983 are assumed to be equipped for standard services. Thus the final number of standard service houses is 1019, i.e. the total number of houses required up to 1983. In 1989 the total houses required are 1289 of which the 1019 constructed to 1983 would be standard service houses and all others, i.e. 270 houses would be all electric, most of which would have been constructed prior to 1989. Thus all new houses from 1989 onward would represent the estimated number of electrically heated homes. For the period from 1983 to 1987 thru 1989, the consumption per house was assumed to be 5000 kWh per annum. The annual consumption of each all-electric home was estimated to be constant throughout the period to 2015 at 23,500 kWh.

Thus the annual residential consumption when the saturation level is reached 1994 to 1996 is estimated at: old houses x 11,750 kWh plus new (all-electric) houses x 23,500 kWh.

vii) Commercial load was estimated as follows:

- For the 1980-1982 period actual consumption was utilized.
- From 1983 onward the consumption under existing conditions was broken down into three major categories, these being:
  - Federally funded usage (including local government).
  - Provincially funded usage.
  - Other Standard General Service usage.

The above consumption was assumed to represent the total electric load other than space heating requirements. The total heating load for the above customers was represented by the electric equivalent of 80% of 2,391,000 litres of fuel oil and propane giving an equivalent of 13315 mWh annually. It was also assumed that as a result of effective energy conservation measures, the annual requirement of fuel oil would remain constant until unrestricted electric power was made available in the communities. For purposes of projecting total commercial load, an annual lighting load growth of 2.3% was assumed commencing in 1983. A similar rate of increase in the heating load was assumed commencing only after unlimited electric service became available and the conversions from oil to electric heat have been made. Total conversion was assumed to occur over an eight year period.

viii) Street lighting load was based on ratio of the average number of street lights to residential services. Based on Manitoba Hydro statistics, the average annual consumption per street light was estimated at 735 kWh, which was the actual annual average in the

communities over the period 1972 to 1981. The total consumption was based on the increasing number of street lights (ratio to increase in number of residential services) multiplied by the average annual consumption per light.

ix) The total annual energy demand is the sum of the residential consumption, all commercial consumption (including heating load) and the street lighting load.

x) Based on Manitoba Hydro statistics for the system generally the annual load factor for unrestricted service has been assumed at 0.40 and this has been applied uniformly to all communities and for the entire period to determine the peak demand.

In order to test the load forecast for sensitivity to various parameters, forecasts were run with differing assumptions and these are shown on Tables 2-9 to 2-14 inclusive (Appendix A).

These various runs were compared to Manitoba Hydro's high feasible forecast Table 2-15 (Appendix A) which basically assumed an annual population increase of 3%, long term people per household estimate of 5.7 to be achieved in 1991 and no escalation in the annual electric energy demand for commercial electric space heating.

The assumptions for the various load projections were identical to those set out above for the Case 1 except as herein below otherwise noted.

b) Case 2: Table 2-9: (Appendix A)

No residential electric space heat considered

c) Case 3: Table 2-10: (Appendix A)

No escalation in commercial space heating requirements

d) Case 4: Table 2-11: (Appendix A)

Average people per household 5.7 effective 1991 and onward

e) Case 5: Table 2-12: (Appendix A)

Average people per household 5.7 effective 1991 and onward and no residential electric space heating considered.

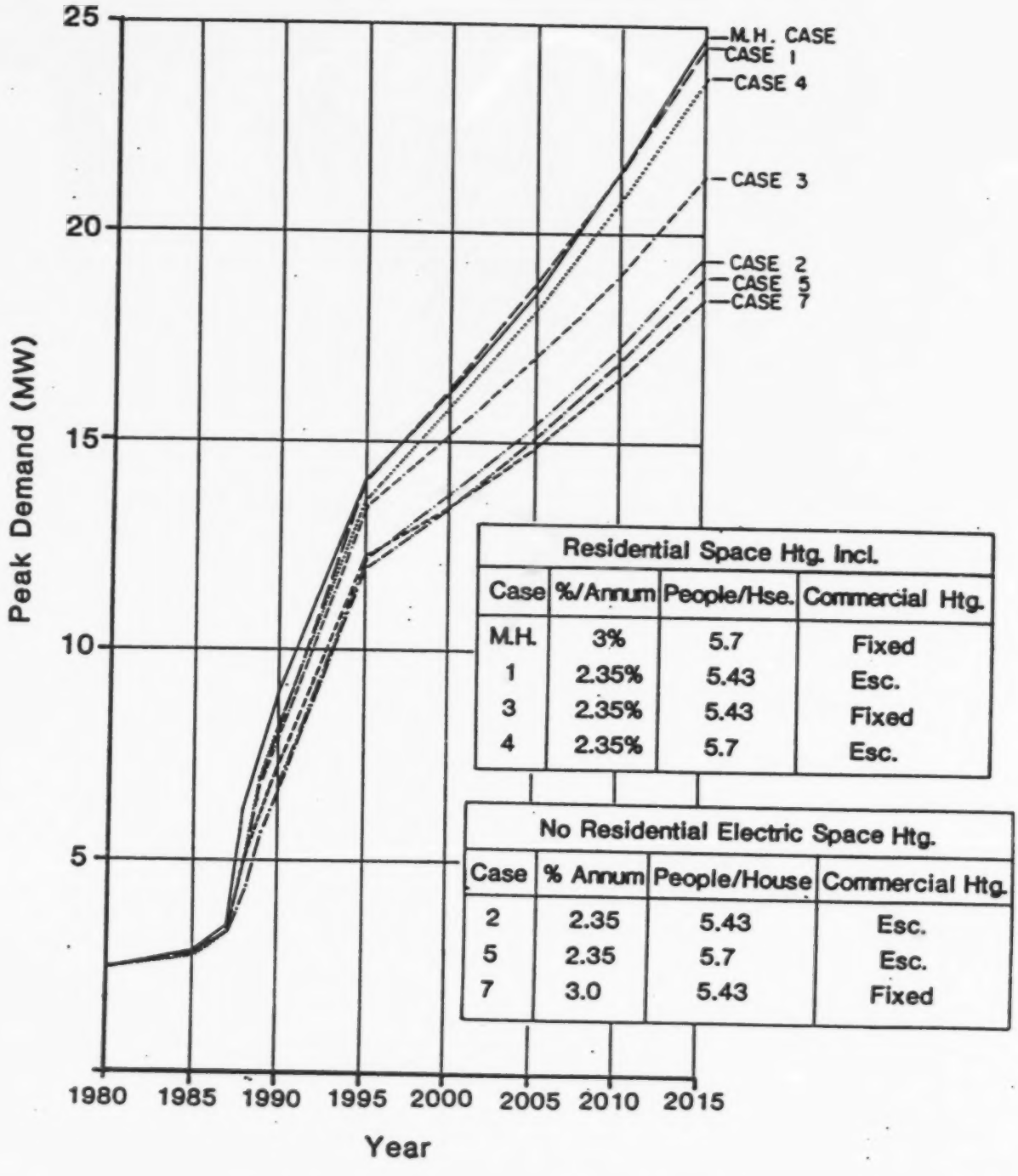
f) Case 6: Table 2-13: (Appendix A)

Average annual population growth 3% and no escalation in commercial space heating requirements

g) Case 7: Table 2-14: (Appendix A)

Average annual population growth 3%, no consideration of residential electric space heating and no escalation in the commercial electric space heating

As a result of the foregoing the variation in total annual energy demand and peak demand as shown on Figure 2-1 is as follows:



Residential Space Htg. Incl.			
Case	%/Annum	People/Hse.	Commercial Htg.
M.H.	3%	5.7	Fixed
1	2.35%	5.43	Esc.
3	2.35%	5.43	Fixed
4	2.35%	5.7	Esc.

No Residential Electric Space Htg.			
Case	% Annum	People/House	Commercial Htg.
2	2.35	5.43	Esc.
5	2.35	5.7	Esc.
7	3.0	5.43	Fixed

FIG. 2–1. NORTH CENTRAL ELECTRIFICATION STUDY
PEAK DEMAND FORECAST 1980/81 to 2015/16 – VARIOUS CASES

	Energy Demand (MWH)	Peak Demand (KW)
Case 1:	85,977	24,536
Case 2:	67,908	19,380
Case 3:	74,811	21,351
Case 4:	83,110	23,719
Case 5:	66,463	18,968
Case 6:	90,193	25,740
Case 7:	64,659	18,454
Case 8: (MH High Reasonable Forecast)	86,541	24,698

Case 8, the Manitoba Hydro High Reasonable Forecast is included herein for comparative purposes and basically supports the forecasts developed in the Study (Table 2-15) (Appendix A).

In analysing the various alternatives for the supply of electric energy to the communities, the Case 1 demand and peak load figures were assumed as the most reasonable projection.

Sources

Korpesho Diana. Regional Housing Official. Indian and Northern Affairs Canada.

Manitoba Department of Northern Affairs. 1982 Census of Remote-Northern Communities. June 1982.

Manitoba Department of Renewable Resources and Transportation Services. A Natural Resources Community Area Analysis - Island Lake Communities. February 1978.

Manitoba Hydro. Island Lake Energy Forecast Vol. II. August 1983.

Signer A.J. and Locatelli C. An Overview of Demographic, Social and Economic Conditions Among Manitoba's Registered Indian Population. Indian and Northern Affairs Canada. December 1980.

Unies Ltd. Report: Energy Profiles for Manitoba Remote Communities. January 1983.

3. COMMUNITY DISTRIBUTION SYSTEM AND HOUSEHOLDER COSTS

It is estimated that six of the seven community distribution systems require upgrading from 12 to 25 kV for the proposed Central System Supply Alternative. These are:

1. Gods Lake Narrows
2. Gods River
3. Red Sucker Lake
4. Garden Hill
5. Waasagomach
6. St. Theresa Point

The extent of this upgrading includes the service drop to each individual residence service entrance mast. The estimated cost of providing the distribution grid under the Central System Supply Alternative includes all the upgrading costs other than the actual service drop to each household. The service drops to individual households will only be upgraded by Manitoba Hydro based on load demand increase, not automatically. Thus the service drop to any consumer presently on restricted service would be upgraded by Hydro should the consumer decide to make full use of electrical energy to the same degree that a southern consumer does. The cost of upgrading a community distribution system is normally borne entirely by Manitoba Hydro and does not affect the individual householder or the cost to the community, irrespective of the type of service with which the individual residence is equipped. If at any time after the connection of a community to the central system supply, a householder decides to upgrade the house wiring and service entrance, Manitoba Hydro will upgrade the service drop to the house if required and at no cost to the resident. However, the cost of up-

grading the household wiring, service entrance, and meter socket is the responsibility of the householder.

The estimated cost at 1983 price levels of upgrading of domestic services is as follows:

1. Upgrading a residence with an existing 15 amp service entrance to a 100 amp service. $1,000

2. Upgrading a residence with a 100 amp service entrance, but equipped with 15 amp main circuit breakers, to full 100 amp service. $100

   This would involve changing the main breaker and upgrading any wiring which does not conform with the electrical code.

3. Upgrading a residence with an existing 100 amp service drop and service entrance and 15 amp main breakers to 200 amp all electric service (to provide for electric heating). $2,500

   This would include a new service drop, a new distribution panel, additional interior wiring, and permanently wired heaters.

Upgrading of domestic services would not be mandatory as a result of central system supply unless the householder desires improved services, such as electric heat or the connection of additional electrical appliances presently not part of the household.

Upgrading of commercial and institutional customer services is also not mandatory as a result of central system supply but most of these customers are now on unrestricted service.

4. CENTRAL SYSTEM SUPPLY ALTERNATIVES

4.1 General

A Central System connection to the communities appears on the surface to be one of the most feasible alternatives available to provide unrestricted service to the communities in the area.

Once this approach is accepted, the basic task is to determine the most economical Central System Supply Alternative with which to provide electricity to the seven communities. In the review three potential, technically feasible supply sources from the Manitoba Hydro Transmission Grid System were identified and investigated.

The three potential electrical supply source alternatives were:

A. Kelsey generating station located 160 km northwest of Oxford House;

B. Jenpeg generating station located 220 km west of Oxford House; and

C. the southern Manitoba Hydro transmission system grid.

Manitoba Hydro had investigated Alternative A in detail and the results of that investigation were presented in Manitoba Hydro report SPD-80-32, dated November 1980. Manitoba Hydro provided this report along with other supplementary data to the study team and this material was reviewed in detail.

Report SPD 80-32 was considered a preliminary feasibility report which was based on preliminary transmission and station costs and load predictions rather than detailed load forecasts.

Since report SPD-80-32 was issued, Manitoba Hydro has initiated a more detailed study of the Central System Supply Alternative. For the subsequent study, a detailed load forecast was prepared for each community which reflects a more accurate count of the existing facilities and is based on historic load consumption and population growth projections. These community forecasts were then combined in order to provide a composite load forecast for the seven communities.

In addition, for the purposes of this study, more accurate transmission and station cost data were produced based on actual material and labour costs for similar projects already completed or nearing completion in northern Manitoba.

These new data were also reviewed in detail, found reasonable and satisfactory, and have therefore been used as base data for the selection and costing of the different Central System Supply Alternatives which follow. The location of the alternatives are shown in Figure 4-1 (Appendix A).

4.2 Description of Alternatives

4.2.1 Alternative A - 138 kV Transmission System from Kelsey Generating Station

Based on current long-term load forecasts preliminary load flow studies prepared by Manitoba Hydro, and the large distance between Kelsey Generating Station and the communities, a 138 kV transmission system voltage is required to maintain satisfactory voltage levels at each community during all load conditions. The proposed transmission line is routed from Kelsey Generating Station to Garden Hill via Oxford House and Gods Lake Narrows, constituting a total length of 325 km of 138 kV transmission line (Figure 4-1, Appendix A) between Kelsey and Garden Hill. A 138 kV transmission line provides sufficient capacity to supply the load forecasted in Table 2-8 (Appendix A) to the year 2015.

A review of Manitoba Hydro's proposed transmission line routing was carried out in conjunction with a review of supplementary information gathered from topographical maps and aerial photographs. On the basis of this review, the proposed routing appears to be technically feasible and was used to prepare cost estimates.

At Kelsey generating station, the line will be terminated in the existing 138 kV switchyard. However, to facilitate the connection of this new line into the present station configuration, one of the existing transmission line terminations would require relocation to a new bay position to

avoid unnecessary and costly crisscrossing of transmission lines. The cost of relocating the existing line is included in the cost estimate for this alternative.

At Oxford House, a new 138 kV to 12 kV transformer station is required to facilitate direct connection into the existing 12 kV distribution system in the community. Minor upgrading of the existing 12 kV distribution system may also be required. However, such upgrading requirements are difficult to forecast and estimate and have therefore not been considered further. These costs would not be significant.

At Gods Lake Narrows, a new 138 kV to 25 kV transformer station is required to facilitate termination of the proposed new 25 kV transmission lines to the communities of Gods River and Red Sucker Lake. These transmission lines are approximately 67 km and 79 km long, respectively. Preliminary load flow studies indicate that 25 kV is the minimum transmission system voltage required to supply these community loads. This voltage would also maintain satisfactory voltage levels without the requirements of additional voltage support equipment throughout the load forecast period. As a result of this requirement, each of these community distribution systems requires upgrading to 25 kV. The upgrading of the existing community distribution systems involves in most cases, changing of pole transformers from 12 kV to 25 kV, their supporting poles, and associated hardware and cables wherever these are part of the primary pole-mounted distribution system such as at river crossings, etc.

The requirements at Garden Hill are similar to those described for Gods Lake Narrows. The communities of Waasagomach and St. Theresa Point will be supplied by means of a 25 kV transmission line from Garden Hill, thus requiring the upgrading of the distribution within each of these communities as well as Garden Hill from 12 to 25 kV.

An alternative to converting an existing distribution system would be to provide 25 kV to 12 kV transformer stations for each community to facilitate connection to the existing 12 kV distribution system. This alternative was investigated but, based on higher material costs alone, is not recommended and was not considered further. In addition, it should be noted that these transformer stations require additional maintenance at added cost and would also detract from the reliability of the community supply.

4.2.2 Alternative B - 138 kV Transmission System from Jenpeg Generating Station

This alternative is based on the identical assumptions with respect to transmission system voltage, load forecasts, and the transmission grid and distribution system configuration within the North Central communities, as the supply from Kelsey station (Alternative A). The cost estimate for this alternative is based upon a transmission line routing from Jenpeg to Oxford House. It is recognized that other line routing alternatives and line termination points to the intercommunity transmission grid are available but since such alternate routings have little impact on the cost difference between Alternative A and B, they have not been considered in further detail. However,

if a supply source from Jenpeg were to be considered a viable alternative for other than economic reasons, a detailed technical review is recommended to determine the most suitable line termination point to the intercommunity transmission grid system. The preliminary line routing selected, based on topographical map information, indicates a total length of approximately 220 km.

Jenpeg generating station is connected to a 230 kV switchyard with spare bay capacity available to facilitate termination of the considered transmission line. Termination of this line, however, would require new 230 kV switching equipment, 230 to 138 kV transformers, and 138 kV switching equipment.

4.2.3 Alternative C - Transmission System from Southern Manitoba Hydro Grid

An extension of the southern Manitoba Hydro grid to Poplar River is being considered by Manitoba Hydro, with a planned in-service date of 1986/87.

A portion of this transmission line to the Bloodvein community has been constructed to ultimately operate at 115 kV, but presently operates at 66 kV. Present Manitoba Hydro transmission plans call for the line from Bloodvein to Poplar River to be designed, constructed, and operated at 66 kV only, with no future upgrading capabilities.

An extension of this line at 66 kV to the North Central communities would not be technically feasible since the additional distance of approximately 220 km between Poplar River and Waasagomach, the closest North Central community, is too long for a 66 kV transmission system voltage. In the absence of detailed load flow studies, it is estimated that a transmission system voltage of at least 115 kV or possibly 138 kV or even 230 kV would be required to economically supply the loads over these distances and to ensure satisfactory voltage regulation throughout the forecast period.

4.3 Additional Considerations

For the above described Central System Supply Alternatives, an alternative transmission system voltage of 66 kV from Oxford House to Garden Hill via Gods Lake Narrows was also considered and investigated. Based on a cost comparison with the 138 kV alternative described above, the 66 kV alternative was not pursued. Although the cost comparison between 66 and 138 kV system voltages appears to marginally favour the 66 kV alternative, additional cost savings will be realized from a 136 kV transmission system due to lower operating costs resulting from lower transmission system losses. It is estimated that the operating costs of a 138 kV transmission system are approximately one-quarter of those of a 66 kV system.

In addition it should be noted that a 138 kV system voltage also provides additional spare capacity for possible future loads. This could be of particular interest since considerable gold mining potential has been forecast for this area, and other mineral development may also take place in northcentral Manitoba.

All Central System Supply Alternatives reviewed are based on a single transmission line tie from the supply source to the North Central communities.

It must be recognized that transmission lines are subject to occasional outages as a result of environmental influences such as ice, sleet, lightning or forest fires, and also from equipment failures, maintenance requirements, and vandalism or accidents. Depending on the severity of the damage caused by any one of these conditions as well as the time of year that the outages occur, the outage duration can vary between a few minutes and a number of days.

There exists the possibility of power outages or interruptions occurring due to damage to the primary transmission line feed into the area between Kelsey and Oxford House and also the possibility of power interruptions on the Hydro Central system, both of which would disrupt service to all the communities. There is the possibility of damage to a single or various legs of the intercommunity grid which might also disrupt service to one or more of the communities. As a result, alternative heating sources such as woodburning or oil-fired furnaces and the like are recommended to provide for emergency spaceheating requirements during outages that may occur in the winter months.

For the purposes of this report, it was assumed that all institutional and commercial customers are presently equipped with the necessary electrical standby generating facilities to provide the emergency standby power requirements during transmission or distribution system outage.

4.4 Capital Cost Estimates

4.4.1 General

Included in these capital cost estimates are all costs for labour, material, equipment, engineering, surveys, and clearing. Not included in the estimated capital costs are land acquisition, owners administration, and interest during construction.

4.4.2 Cost Estimate - Alternative A

- 138 kV Transmission System from Kelsey Generating Station to North Central Communities.

	1983 $ x 10^3	
- 138 kV Transmission Line		
- Kelsey to Oxford House (160 km)	9,120.	
- Oxford House to Gods Lake Narrows (75 km)	4,275.	
- Gods Lake Narrows to Garden Hill (90 km)	5,130.	
Subtotal 138 kV transmission		18,525.
- 25 kV Transmission Line		
- Gods Lake Narrows to Gods River (67 km)	1,876.	
- Gods Lake Narrows to Red Sucker Lake (79 km)	2,212.	
- Garden Hill to Waasagomach (32 km)	896.	
- Waasagomach to St. Theresa Point (9 km)	252.	
Subtotal 25 kV transmission		5,236.
- Station Costs		
- Kelsey station: termination of 138 kV transmission line	1,200.	
- Oxford House: 138-12 kV transformer station	1,400.	

- Gods Lake Narrows: 138-25 kV transformer station	3,000.	
- Garden Hill: 138-25 kV transformer station	1,650.	
Subtotal station cost		7,250.
- 12 to 25 kV Conversion Costs		
- Gods Lake Narrows	168.	
- Gods River	28.	
- Red Sucker Lake	37.	
- Garden Hill	334.	
- Waasagomach	161.	
- St. Theresa Point	163.	
Subtotal conversion costs		891.
- Clearing of Right-of-Way (30 meters wide) Assume that all transmission line right-of-ways will be cleared by hand as opposed to machine clearing.		
512 km (1562 ha) at $2,470/ha		
Subtotal clearing cost		3,859.
GRAND TOTAL - ALTERNATIVE A		35,761.

4.4.3 Cost Estimate - Alternative B

- 138 kV Transmission System from Jenpeg Generating Station to North Central Communities.

	1983 $ x 10^3	
- 138 kV Transmission Line		
- Jenpeg to Oxford House (220 km)	12,540.	
- Oxford House to Gods Lake Narrows (75 km)	4,275.	
- Gods Lake Narrows to Garden Hill (90 km)	5,130.	
Subtotal 138 kV transmission		21,945.

- 25 kV Transmission Line

- Gods Lake Narrows to Gods River (67 km)	1,876.	
- Gods Lake Narrows to Red Sucker Lake (79 km)	2,212.	
- Garden Hill to Waasagomach (32 km)	896.	
- Waasagomach to St. Theresa Point (9 km)	252.	
Subtotal 25 kV transmission		5,236.

- Station Costs

- Jenpeg transformer station: termination of 138 kV transmission line	2,500.	
- Oxford House: 138-12 kV transformer station	1,400.	
- Gods Lake Narrows: 138-25 kV transformer station	3,000.	
- Garden Hill: 138-25 kV transformer station	1,650.	
Subtotal station cost		8,550.

- 12 to 25 kV Conversion Costs

- Gods Lake Narrows	168.	
- Gods River	28.	
- Red Sucker Lake	37.	
- Garden Hill	334.	
- Waasagomach	161.	
- St. Theresa Point	163.	
Subtotal conversion costs		891.

- Clearing of Right-of-Way (30 meters wide)
  Assume that all transmission line right-of-ways will be cleared by manpower.

572 km (1745 ha) at $2,470/ha	
Subtotal clearing Cost	4,309.
GRAND TOTAL - ALTERNATIVE B	40,931.
Thus Total Additional Cost Over Alternative A	5,170.

4.4.4 Cost Estimate - Alternative C

- 138 kV Transmission System from the Southern Manitoba Hydro Grid to North Central Communities.

This cost estimate is based on a comparison of additional transmission costs only for a southern system supply versus a supply from Kelsey generating station.

For the purposes of this comparison, it is assumed that the 115 kV line terminating at Bloodvein will be extended to Poplar River and Waasagomach. The line costs are assumed to be the same as those indicated for 138 kV. Furthermmore, Waasagomach rather than Oxford House is assumed to be the transmission line receiving station for the North Central area.

Additional costs for a southern system supply source over and above the costs for the Central System tie to the Kelsey station:

	1983 $ x 10^3
- Bloodvein to Waasagomach	
- 180 km of 115 kV transmission line Bloodvein to Poplar River	10,260.
- 240 km of 115 kV transmission line Poplar River to Waasagomach	13,680.
- Right-of-Way Clearing Poplar River to Waasagomach, 240 km (732 ha)	
- 240 km (732 ha) at $2,470/ha	1,808.
Total Additional Transmission Line and right-of-way clearing costs - Alternative C	25,748.

Transmission line costs only for Alternative A: (Kelsey to Oxford House)	
- 160 km of 138 kV transmission line Kelsey to Oxford House	9,120.
- Right-of-way clearing Kelsey to Oxford House, 80 km (488 ha)	
- 160 km (488 ha) at $2,470/ha	1,205.
Total transmission line and right-of-way clearing costs as per Alternative A	10,325.
Thus Total Additional Costs Over Alternative A	15,423.

It should be noted that this estimate includes the transmission line and right-of-way clearing costs only which are compared to those of Alternative A. All other costs for Alternative C are assumed to be similar to those of Alternative A.

Not included in the Alternative C estimates are the additional station costs at Bloodvein and Poplar River and the cost of redesigning or possibly rebuilding of the 66 kV transmission system from Bloodvein to Poplar River or the possible improvements to the existing right-of-way which may be required. All of these extra costs would tend to further increase the cost of a southern feeder to the communities.

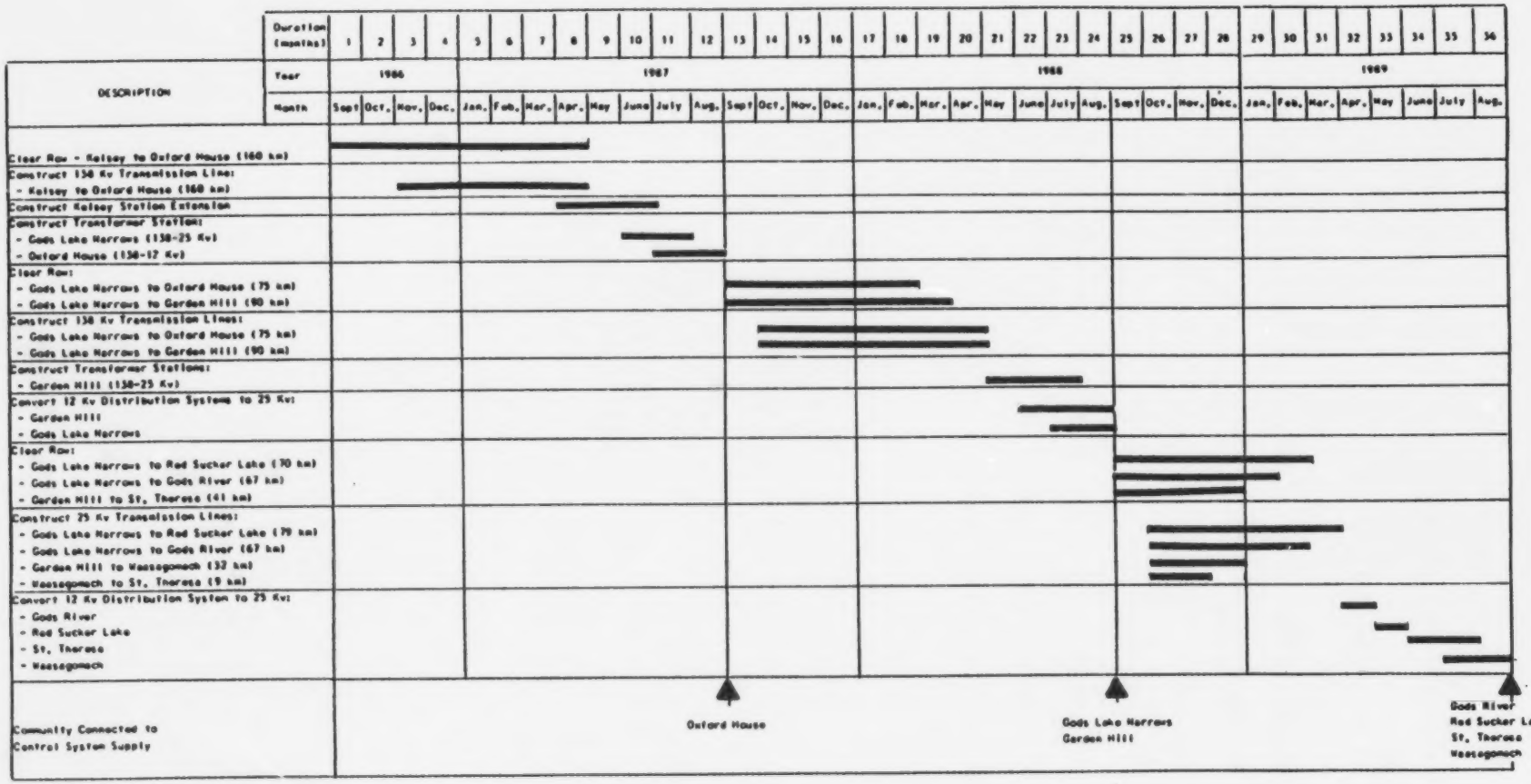
4.5 Conclusion

Based on a capital cost comparison of the three possible alternatives, Alternative A, a 138 kV transmission system from the Kelsey generating station to Oxford House and Garden Hill, has been selected as the most economical cen-

tral system supply alternative and is the recommended central system supply arrangement.

As indicated in Figure 4-2, a three-year construction schedule has been estimated for this project. This schedule allows for winter construction for the right-of-way clearing and the transmission line construction phases of the project. Other construction activities such as transformer station construction, conversion and upgrading of community distribution systems have been assumed to be summer construction activities. While the schedule shown is reasonable, other sequences or a longer period could easily be adopted if necessary.

For the purposes of projecting costs, year one of the Construction Program would extend from September 1986 to August 1987.


Duration (months)
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36
DESCRIPTION
Year
1986
1987
1988
1989
Month
Sept Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug.
Clear Row - Kelsey to Oxford House (160 km)
Construct 138 Kv Transmission Line:
- Kelsey to Oxford House (160 km)
Construct Kelsey Station Extension
Construct Transformer Station:
- Gods Lake Narrows (138-25 Kv)
- Oxford House (138-12 Kv)
Clear Row:
- Gods Lake Narrows to Oxford House (75 km)
- Gods Lake Narrows to Garden Hill (90 km)
Construct 138 Kv Transmission Lines:
- Gods Lake Narrows to Oxford House (75 km)
- Gods Lake Narrows to Garden Hill (90 km)
Construct Transformer Stations:
- Garden Hill (138-25 Kv)
Convert 12 Kv Distribution Systems to 25 Kv:
- Garden Hill
- Gods Lake Narrows
Clear Row:
- Gods Lake Narrows to Red Sucker Lake (70 km)
- Gods Lake Narrows to Gods River (67 km)
- Garden Hill to St. Theresa (41 km)
Construct 25 Kv Transmission Lines:
- Gods Lake Narrows to Red Sucker Lake (79 km)
- Gods Lake Narrows to Gods River (67 km)
- Garden Hill to Waasegomach (32 km)
- Waasegomach to St. Theresa (9 km)
Convert 12 Kv Distribution System to 25 Kv:
- Gods River
- Red Sucker Lake
- St. Theresa
- Waasegomach
Community Connected to Control System Supply
Oxford House
Gods Lake Narrows
Garden Hill
Gods River
Red Sucker Lake
St. Theresa
Waasegomach

Note: (1) Row-Right-of-Way

FIGURE 4-2
PROPOSED ISLAND LAKE CONSTRUCTION SCHEDULE
FOR CENTRAL SYSTEM SUPPLY (ALTERNATIVE A)

5. LOCAL HYDRO GENERATION ALTERNATIVE

5.1 General Area Description

The study area is characterized by two major lakes. Island Lake is connected to Gods Lake by the Island Lake River, through Beaver Hill Lake, and the Kanuchuan River. The outlet from Gods Lake is via Gods River.

Existing studies and mapping available were assembled and reviewed and various possible hydro generation sites were identified. Based on the information available, it was confirmed that the seven potential sites identified and recommended by Manitoba Hydro in Report No. SPD 80-32 dated November 19, 1980 were indeed the most likely sites, these being:

- o Bad Rapids
- o Kanuchuanus 1 and 2
- o Kanuchuan 1 and 2
- o Gods River 1 and 2

The map showing the location of the proposed hydro development and associated transmission and station requirements is enclosed (see Figure 5-1, Appendix A).

There are other sites in the area that could perhaps be developed; however, the sites chosen can be considered representative. These sites have

the added advantage that they would make use of virtually the entire head available. Accordingly they are studied and described in some detail in this section.

5.2 Approach

The approach taken was to review the data available for each potential hydro site, to verify the data by a visit to the site, and to then analyze the data and prepare comparison cost estimates for developments at the various sites.

The base data for this investigation including installed capacity, minimum firm flow, the head at each site, and topographical and geological maps for each site were made available by Manitoba Hydro through report SPD 80-32, dated November 19, 1982 and supplementary backup data. This information is summarized in Table 5-1 (Appendix A). In addition, more data were collected during a site visit to each potential site, to assess and ascertain the specific features relating to the construction and site development.

The site visits were a reconnaissance by helicopter, in mid-October 1983. All seven potential sites were visited briefly. In general, this reconnaissance indicated that all sites are relatively similar and that none are expected to be significantly more difficult or easier to develop than any of the others.

For the purposes of this study it was assumed that the potential hydro sites and the individual communities will be interconnected with a 66 kV and 25 kV transmission grid as shown in Figure 5-1 (Appendix A).

The transmission grid voltages were selected by Manitoba Hydro based on preliminary load flow studies, and a review of these studies indicates that they were technically feasible and could therefore be used for further economic analysis.

As a result of the transmission grid voltages selected, some of the existing community distribution systems will require upgrading to 25 kV, to facilitate termination of the 25 kV transmission line legs. The proposed conversion requirements are discussed under the Central System Alternative in Section 4 and the costs are reflected in the attached cost estimate (see Table 5-9, Appendix A).

The environmental impact of the construction and operation of the transmission grid for the Local Hydro Alternative is similar to that for the Central System Alternative discussed in detail in Section 9.

5.3 Cost Estimate Methodology (Hydro Sites Only)

The cost estimates for the Hydro sites reported herein are all based on a computer program which uses 13 parameters to calculate the costs for the major components of small-scale hydro developments. These costs are produced for each potential site. The costs are based on a formula developed on the basis of similar project components for other existing developments.

The program was developed to estimate costs of small-scale hydro sites in New Brunswick and Prince Edward Island. Since the sites in northern Manitoba are remote sites, the program was calibrated to reflect the costs associated with northern construction. An 11 MW development, constructed on the Charlot River in Northern Saskatchewan, was used for calibration purposes.

The thirteen parameters that are used in the computer program for calculating costs for the various components associated with each site are listed below:

- installed capacity;
- rated head - the head at each site was reviewed to determine the extent of upstream flooding;
- design flow;
- penstock length - taken from topographical maps;
- access road lengths - the length of access road was measured to the nearest known winter road;
- transmission line lengths - the length of transmission line was measured from the hydro site to the proposed inter-connection grid;
- dam height - taken from topographic maps;
- dam lengths - taken from topographic maps;
- distance to the nearest town - this parameter is used in calculating engineering and owner's costs as related to travel time; once it is greater than 60 km, there is no further influence by this parameter; for each site, a nominal value of 100 km was used;
- distance to nearest concrete plant - this parameter is used the same way as the nearest town parameter is used; the maximum distance exceeds 60 km and a greater value has no further effect; the value used for all sites was 100 km;
- flood flow - the flood flow parameter was calculated for each site by prorating the known flood flow value for the Bad Rapids site;

- fishway factor - fishway costs have been included in the estimated cost of development; and
- number of units - it was assumed that all sites would be multiple unit developments.

Most of these data were obtained from Manitoba Hydro and from the studies carried out by Manitoba Hydro. The information and data were verified where feasible by the site reconnaissance.

The program also calculates the "least cost" of development for comparison purposes. The "least cost" formula is based on the statistical analysis of cost data obtained for over 170 projects. The formula relates installed capacity and head to the cost of a development with preferred site characteristics (Ref: "Hydropower Cost Estimates:, by Gordon, Waterpower, November, 1983).

5.4 Development of Sites

5.4.1 Island Lake River

Island Lake River has a natural drop of approximately 27 metres. Three potential sites have been identified on the River, with a total developed head of 26.7 m (see Figure 5-2, photographs 1, 2, and 3, Appendix A). These are the Bad Rapids, Kanuchuanus #1, and Kanuchuanus #2 sites.

The designated minimum firm flow of 70.8 m^3/sec is dependent on the development of the Bad Rapids site prior to construction of Kanuchuanus #1 or #2 plants. The site data used to derive the capital cost estimates for these

sites are shown in Table 5-2 (Appendix A). Table 5-3 (Appendix A) shows a breakdown of the cost estimates for these sites. Full development of Island Lake River would provide 22 MW at an average cost of $4,699/kW in 1983 dollars.

5.4.2 Kanuchuan River

The Kanuchuan River has a natural drop between Beaver Hill Lake and Gods Lake of approximately 21.7 metres.

The remains of a hydro plant on the Kanuchuan River were briefly examined and rejected for further consideration in this study.

The two sites identified on the Kanuchuan River would have a total developed head of 21.3 metres (see Figure 5-3, photographs 4 and 5, Appendix A). The designated firm flow is dependent on the construction of site no. 1 initially to regulate the flow from Beaver Hill Lake. Full development of the Kanuchuan River would provide 21.9 MW at an average cost of $4,041/kW in 1983 dollars. The site data used to derive the capital cost estimates are shown in Table 5-4 (Appendix A) and the resulting cost estimates are shown in Table 5-5 (Appendix A).

5.4.3 Gods River

The two sites identified on Gods River (see Figure 5-4) would develop 14 metres of the available 16.4 metres of head between Gods Lake and

the tailwater of site no. 2. Relevant site and cost data for these sites are given in Table 5-6 (Appendix A) and the resulting cost estimate in Table 5-7 (Appendix A).

These developments on Gods River would provide a total of 18.4 MW at an average cost of $4,658/kW in 1983 dollars.

5.4.4 Comparison of Plants

A summary of the capital cost estimates for the seven sites investigated and the associated interconnecting transmission grid are listed below. As a check on the reasonableness of these estimates, an estimate was prepared for each site based on a derived relationship between cost, head, and installed capacity that provides an estimate of the least capital cost expected for any site. As previously stated, this is a statistical relationship derived from analyses of a large number of existing projects. This minimum cost estimate is also included in the following table. As can be seen from the table, the estimated cost is always higher than the statistical minimum cost by amounts ranging from 1.5% to 4.2% for all sites except Bad Rapids. The estimate for the Bad Rapids site is substantially higher than the least cost estimate (by 13.7%) and this is due to the length of the dam which includes side dams required to close the reservoir.

Summary of Development Costs
(Excluding Interest During Construction)
(Millions of 1983 Dollars)

Watershed	Site Name	Installed Capacity MW	Minimum Cost (million $)	Project Cost (million $)	Cost/kW ($)
Island Lake River	Bad Rapids	8.2	34.42	39.13	4772
	Kanuchuanus #1	7.0	31.46	32.14	4592
	Kanuchuanus #2	6.8	30.99	31.45	4624
Kanuchuan River	Kanuchuan #1	11.6	44.38	45.47	3919
	Kanuchuan #2	10.3	41.49	43.03	4178
Gods River	Gods River #1	7.9	37.85	39.44	4992
	Gods River #2	10.5	44.53	46.26	4406
Interconnecting Transmission Grid		N/A	N/A	19.50	N/A

For details of these cost developments refer to Appendix A.

The recommended sequence of development to meet the increasing load demand in the future is as follows:

1. Kanuchuan #1
2. Kanuchuan #2
3. Bad Rapids
4. Kanuchuanus #1
5. Kanuchuanus #2
6. Gods River #1
7. Gods River #2

This recommended order of development is based on the requirement that upstream sites on each of the rivers be developed first to allow adequate flow regulation to provide the given minimum flows. Since it is expected that the total available capacity will ultimately be required, partial development of sites within a watershed has not been considered.

The capital costs shown include only a nominal allowance for transmission facilities (a total of 2.1 km for the first three plants to be installed). Significant additional transmission is required to interconnect each of the communities to each other and to the proposed hydro plants. The required transmission facilities and their estimated capital costs are shown on Table 5-8 (Appendix A), and based on a three year construction schedule (1987-1989) the Cash Flows anticipated are shown on Table 5-9 (Appendix A). This allows for 226 km of single circuit 66 kV lines, 146 km of 25 kV lines and 9 km of 12 kV lines. In addition transformer stations are required to step the voltage down to the required community distribution system voltage.

6. ALTERNATIVE ENERGY SYSTEMS

6.1 General

The following alternative energy options for generation of electrical power for the North Central communities, at a central station located at Gods Lake Narrows were considered.

- Diesel generation
- Wood-fired boiler/steam turbine generation
- Wood gasification dual-fuel engine generation
- Solar energy generation
- Wind energy generation
- Peat-fired steam turbine generation
- Hybrids

A brief analysis was undertaken to compare the advantages of continuing to provide service to each community on an isolated basis. For this alternative, the present policy of requiring 100% reserve capacity was used. This was compared with an alternative of inter-connecting all communities and providing a central supply of power from various thermal alternatives. For technical and economic reasons, supply from a centralized plant is preferred and the remainder of this section analyzes the different thermal alternatives that might be feasible.

For purposes of this analysis, all units are assumed to be located at one plant. The site chosen is Gods Lake Narrows because (a) the transmission grid radiates from there in four directions and (b) it is the most central location for supplying the forecasted loads in the communities. If this alternative were to be selected, additional site selection analyses would be

required to optimize the specific site for the first two units and to then select sites for the additonal units. For instance, load flow studies might suggest that a unit should be located at another community for technical reasons.

Based on a detailed review of the above, a number of these options have been eliminated from further evaluation as a result of the review and those which remain have been subjected to technical and cost evaluation and environmental impact review.

This evaluation is based on the following assumptions:

- The load forecasts shown below have been used for unit size selection in each case.

Year	1990	2000	2010	2015
Total Peak Demand (kW)	8,149	16,368	21,489	24,536
Increase (kW)		8,218	5,121	3,047
Increase (%)		101	31	14
Increase Index (1990=100)	100	201	264	301
Consumption (MWH/yr)	28,556	57,350	75,297	85,377

- The existing diesel units at each community have been assumed to constitute adequate standby capacity.
- Installed station capacity at Gods Lake Narrows should equal the total peak demand shown above.
- Average annual load factor is 40%.
- Transmission and distribution losses are assumed at 3.5%.
- No firm capacity criteria are applied since the existing local diesel generating stations are expected to provide the required standby capacity.

6.2 Approach and Methodology

A pre-feasibility approach has been applied to developing a methodology suitable for this level of study. Where necessary, reasonable assumptions have been made with regard to resources and technical and economic parameters applicable to plant selection and cost estimation of energy alternatives.

Unit size selection, based on the peak demand for 1990, has dictated the basic technology for each energy alternative. Since the increments in installed capacity in successive stages of expansion for years 2000, 2010, and 2015 are seen to be of similar orders of magnitude, it has been possible to factor capital and O&M costs for incremental expansion from the estimates prepared for the initial (1990) installation.

Available resource data have been applied to the review of energy alternatives in order to eliminate those alternatives which do not warrant further evaluation due to lack of the required energy resource. Reasons for such elimination have been stated in each case.

While advanced technology has been reviewed, only proven technology has been evaluated and considered.

6.3 Review of Alternatives

Of all the alternatives reviewed, it was determined that only the diesel and wood fired thermal plants required additional consideration. These alternatives are discussed in detail in section 6.4.

Those alternatives that were rejected from further considerations are discussed briefly below.

6.3.1 Wood Gasification Dual-Fuel Engine Generation

The data currently available do not indicate that the system utilizes proven technology in North America. Some European suppliers claim to have successfully operated dual-fuel (biomass and diesel) engine driven generators fired by low calorific value gas generated in small biomass gasifiers. A few suppliers in North America are attempting to establish a demonstration project but report that technical problems, related mainly to the dual-fuel engine and its coupling with the gasifier, remain to be solved.

6.3.2 Solar Energy Generation

A small photovoltaic unit represents a technically attractive extension to diesel, biomass, or even central system generation.

On the basis of the solar insolation at Gods Lake Narrows, it is estimated that a 100 kWp photovoltaic array would generate 140 to 220 MWh per

year. In a year of average sunshine, an output of 180 MWh may be expected. After deducting losses of 6%, the unit would provide approximately 170 MWh per year to the system.

At current costs of approximately $12,000 per kilowatt installed at Gods Lake Narrows, a 100 kWp unit would cost $1,200,000.

The unit would be guaranteed for 20 years and is expected to have very low annual maintenance requirements. Photovoltaic units are considered particularly suitable for remote locations because, having no moving parts to wear out, they are expected to give many years of trouble-free service.

As a modular extension to a generating station, a photovoltaic generator would be connected to the system through a power conditioning unit which would invert the Direct Current generated to line Alternating Current voltage regulation. The photovoltaic module would put energy directly into the interconnected system (no energy storage considered) during hours of sunshine only and thereby reduce diesel or biomass fuel requirements during normal operation.

The incremental cost of a photovoltaic installation is such that it would not be economical to supplement either the diesel or biomass alternative. Even though the cost of photovoltaics is expected to drop considerably in the coming decade such that it could be as low as about $4,000 per kWp (versus the present $12,000) this would not be sufficient to compete with the present energy costs on the Manitoba Hydro system.

6.3.3 Wind Energy Generation

The wind energy alternative has been reviewed and, on the basis of the wind data currently available for the North Central communities, it is considered that there is not a sufficient wind resource to justify evaluating this option.

Wind data are collected by the Atmospheric Environment Service for Brandon, Dauphin, Portage la Prairie, The Pas, Winnipeg, Churchill, and Thompson.

Interpretation of these data indicates that the mean annual wind speeds at Gods Lake Narrows are too low to warrant wind energy generation. Velocity duration data are not available. New data are under preparation and will shortly be published by the Atmospheric Environment Service. With this information, it may become possible to construct a velocity-duration pattern from hourly data, but present indications do not promise viability. This option has, therefore, not been further evaluated.

6.3.4 Peat-Fired Boiler Steam Turbine Generation

The following data were reviewed with regard to fuel peat resource:

- Technical Report No. 78-7: Biophysical Land Classification, Oxford House 53L, including map.
- Technical Report No. 78-2: Biophysical Land Classification, Knee Lake 53M, including map.

Several further examinations of peat resource potential at similar latitudes in Manitoba and Saskatchewan were conducted. Large quantities of peat, including areas with depths in excess of 3 metres, were recently located in Saskatchewan near the Manitoba border at the same latitude as Gods River.

For the purposes of this report, however, there are insufficient data to warrant an evaluation of a peat-fuelled power generation system. But biomass-fuelled generation has been evaluated. Should further analysis indicate that the biomass alternative is feasible, it may be worthwhile to further review the peat fuel resource. On the other hand, if biomass-fuelled generation should not warrant further consideration, it may be assumed that a peat alternative would also not be favourable.

6.3.5 Hybrids

Wind-diesel hybrids have been eliminated due to lack of adequate wind energy resources at the North Central communities. For the same reason, wind-hydro hybrids are also omitted from the evaluation.

6.4 Comparison of Selected Options

6.4.1 General

The following primary options have been selected for technical and cost evaluation:

- diesel generation;
- wood-fired boiler/steam turbine generation.

Both the primary options have been evaluated for an initial installed capacity equal to the peak demand in 1990, which is 8149 kW. Subsequent expansions in years 2000, 2010, and 2015 are factored from the evaluation of initial capacity.

6.4.2 Technical Description of Plant

A general description of the technical aspects of the biomass and diesel systems are as follows.

6.4.2.1 Biomass System

The peak demand in 1990 is 8149 kW and this demand would be provided by two 5.0 MW gross capacity boiler/turbine generator sets. For additional loads beyond 1990, it has been assumed that incremental units of the required capacity of similar design and with similar specifications would be provided.

The technical parameters for this alternative are provided in Table 6-1. The plant would consist of the following primary elements:

- Boiler and Auxiliaries
- Turbine Generator and Auxiliaries
- Cooling System
- Fuel Storage System
- Ash System
- Electrical System

6.4.2.2 Diesel Generator System

The peak demand in 1990 would be similar to that considered for the biomass alternative and would be provided by two diesel engine-driven generators of 5.0 MW gross capacity each. For subsequent expansions, it is assumed that incremental units of the required capacity and similar design and specification would be installed.

The technical parameters of the plant are given in Table 6-1. The plant would consist of the following primary elements:

- Fuel oil storage (2-years) and transfer system.
- Charge air radiator.
- Motor driven service and instrument air compressors.
- Air receiver.
- Jacket water system.
- Diesel engine and coupled alternator.
- Fuel service tank.
- Air-cooled system for jacket water, lube oil, and turbocharged combustion air system.
- Exhaust silencer and stack.
- Control panels and switchgear, synchronizing and load sharing systems.
- Electrical systems and equipment including, and up to, the station transformers.

6.4.3 Cost Comparison

The following basic data and assumptions have been applied to the evaluation:

Delivered price of diesel No. 2 fuel oil (Price: $0.9456/gal + haulage: $0.2609/gal = $1.2065/gal) @ $38.46 MJ/LItre	$0.2654/litre
Delivered price of hogged wood fuel to site @ 50% moisture content and HHV (higher heating value) of 9.9 GJ/Tonne	$25/tonne

Table 6-1

Technical Parameters - Biomass and Diesel Generation

	UNIT	BIOMASS-FIRED BOILER STEAM TURBINE GENERATION	DIESEL ENGINE GENERATION
		2 x 5,000 kW	2 x 5,000 kW
Max. Cont. Rating, Gross	kW	10,000	10,000
Station Service	kW	700 (1)	400 (2)
Max. Cont. Rating, Net	kW	9,300	9,600
Gross Heat Rate (NHV of Fuel)	kJ/kWh	22,262	9,666
Net Heat Rate (NHV of Fuel)	kJ/kWh	23,937	10,069
Lube Oil Consumption	l/kWhr	-	0.002833
Annual Maintenance		500	450
Forced Outage Rate	%	12	8
Availability	%	85	87
Estimated Service Life	Years	30	25
Steam Conditions: - Press. at Turb. Throttle - Temp. at Turb. Throttle	 kPa °C	 4,237 (615 psia) 400 (750°F)	
Back Press at Condenser	kPa	10 (3" Hg)	
Estimated Weight of Plant Transported to Remote Location	Tonnes	950	700

(1) Estimated at approximately 7% of maximum continuous rating.

(2) Estimated at approximately 4% of maximum continuous rating.

Delivered price of lube oil to site (Price including haulage = $6.2609/gal)	$1.3775/litre
Cost for equipment transportation to remote Manitoba location	$2.00/tonne-km
Assumed distance of equipment transportation to remote location	500 km

Unit size selection to supply peak demand in 1990 is as follows:

Biomass: 2 x 5,000 kW = 10,000 kW
Diesel: 2 x 5,000 kW = 10,000 kW

The capital and operating costs of these alternatives are shown in Table 6-2.

Table 6-2

Cost Evaluation - Biomass and Diesel Generation

	STEAM PLANT (2 x 5,000 kW)	DIESEL PLANT (2 x 5,000 kW)
	1983 $ x 1000	1983 $ x 1000
A. Capital Costs		
- Land & Right-of-Way	Excluded	Excluded
- Site & Improvement	300	300
- Civil Account	4,300	2,250
- Mechanical Account	12,100	3,750
- Electrical and I&C Account	4,300	1,500
- Off-sites:		
- C.W. System (provision)	430	
- 2 yrs. oil storage @ $6/bbl	350	850
- Allowance for transportation to remote site @ $2/T-km for 500 km	950	700
- Construction, Engineering, and Project Management	4,200	1,730
- Owner's Costs	1,000	410
TOTAL CAPITAL INVESTMENT (TCI)	27,930	11,490
Specific Cost $/kW Installed	2,793	1,149
B. Annual Costs		
Fixed Costs:		
- Capital Charges	(Economic Analysis)	(Economic Analysis)
- Insurance	0.25% of TCI	0.25% of TCI
- Interim Replacement	0.35% of TCI	0.50% of TCI
- Administration	0.4% of TCI	0.4% of TCI
- Operating Cost	770	420
Incremental Costs: (with plants operating at 80% capacity)		
- Fuel		
Biomass	1,659	
Auxiliary Oil	800	
Diesel Fuel		2,244
Lube Oil		131
- Operating & Maintenance	80	200

7. COMPARISON OF SUPPLY ALTERNATIVES

7.1 General

In this section, the costs of supplying electric power to the North Central communities are compared for the following alternatives:

(a) Connection of the communities to the Manitoba Hydro Central Grid.

(b) Development of local hydro generation sites close to the communities.

(c) Connection of communities to a central biomass-fired thermal plant.

(d) Interconnection of communities and expansion of diesel generation.

Each of the four alternatives listed above is based on the assumption that all seven communites are supplied as a group rather than individually. In addition, it is assumed that each alternative is sized to supply the projected unrestricted load forecast as indicated in Figure 2-8.

The alternatives are compared on the basis of the present worth of their annual capital-related, and operating costs over the period 1989 to 2015. The alternative with the lowest present worth cost is viewed as the most economical alternative.

In calculating the annual capital costs, fixed charge rates were applied to the estimated total capital investment costs. Under this method, the cost of developing each new facility is spread out over its economic life. With different economic lives for the various facilities, this

approach is more reasonable than recognizing the total capital investment costs at the time of the commissioning of each new facility.

7.2 Economic Parameters

The estimates of both capital and operating costs of facilities required to supply future growth in demand may be expressed in current dollars or in constant dollars. Current dollar estimates reflect the effects of inflation resulting in changing price levels, and the interest rate used in determining the present worth of cash flow streams must include an allowance for inflation which anticipates such price changes. Constant dollar estimates, on the other hand, are based on money of constant purchasing power and, in comparing such data, the interest rate used excludes any allowance for inflation. If the interest rates used in the two types of estimates are consistent with the projected trend in inflation, then either comparison method may be used to calculate the present worth of sequences of estimated future expenditures and the results will be identical. Considering the difficulty which economists are having in arriving at a consensus of future rates of inflation in Canada, it was considered appropriate to carry out this analysis in terms of constant 1983 dollars.

The appropriateness of escalating the cost components at different real rates of escalation was considered. Although each is expected to escalate at different rates, there are insufficient data to permit an estimate of a rate for each cost component. For purposes of this analysis, it is assumed that each cost component will escalate at the general inflation rate; that is that the differential real escalation for each cost component will be zero.

The cost of capital selected must be consistent with the escalation assumptions used. Since the analysis is being done in constant dollar terms, the cost of capital selected should not contain any allowance for escalation. It is estimated that the real cost of capital to the electric power industry in Canada is in the order of 6 percent and discount rates of 4%, 6%, and 8% were used in the analysis.

The service life of a component of a power system is the length of time over which its capital cost is amortized and this amount is included in computing power costs. A long physical life is reasonably possible for any one component, particularly for durable structures, but factors other than physical deterioration tend to limit the useful life. For purposes of economic comparison, the relative lives of different types of generating plant and associated transmission facilities, rather than their absolute lives, are the important consideration.

Records from the electric power industry indicate that service lives of hydro plants from 50 to 100 years are commonly used for hydro projects. A service life of 67 years was chosen for use in this report as it is a figure that has been used by Manitoba Hydro.

The economic lives of the thermal plants depends to some extent on the severity of use to which they are put, the severity of their environment and the type of unit. For purposes of this analysis, the economic lives of the diesel units and the biomass-fired thermal units will be assumed at 25 years and 30 years, respectively.

For transmission lines, and sub-transmission lines interconnecting the communities, service lives of 40 years and 30 years, respectively, were chosen.

In summary, the useful lives of the various types of facilities to be installed as the components of either the Central System Supply or the Local Hydro Alternatives were assumed to be:

Hydroelectric Plant	67 years
Transmission Line	40 years
Transmission Grid	30 years
Thermal Plant	30 years
Diesel Plant	25 years

Fixed charge rates for depreciation and interest cost are as follows:

	Discount Rate		
Useful Life	4%	6%	8%
67 years	0.04319	0.06129	0.08050
40 years	0.05052	0.06646	0.08386
30 years	0.05783	0.07265	0.08883
25 years	0.06401	0.07823	0.09368

The energy consumptions and peak demands used for this analysis are based on those shown in Figure 2-8. Unrestricted service was assumed to be available to all communities in 1989 under each alternative. This analysis disregards the additional benefits that would accrue to the Central System Supply Alternative due to the earlier connection of some communities.

In the case of the Local Hydro and Thermal Alternatives, it has been assumed that sites will be developed to meet the forecasted peak loads with no allowance for reserve capacity. This is considered to provide a system of approximately comparable reliability to the alternative of interconnecting with Manitoba Hydro's Central Grid which is based upon a single circuit transmission line 160 kilometres long between Kelsey Generating Station and Oxford House. We understand that it is Manitoba Hydro's practice to remove the diesel generators once a community is provided with unrestricted electrical energy.

A three-year construction period has been assumed for each hydro generation site including its associated transmission grid, as well as for the transmission line and distribution grid under the Central System Supply Alternative. For the diesel plants and thermal plants, a two-year construction period was assumed. For detailed construction schedules for the transmission line and grid, refer to Appendix A).

7.3 Capital Investment

A number of potential hydro generation sites in the vicinity of the communities have been considered, and preliminary cost estimates for each site are included herein. The constraints of the present study precluded a detailed examination of hydro generation development sequences and, therefore, the method of comparison was also less detailed. A preliminary screening of the costs of the various generating plant sites was made in order to achieve a preliminary economic ranking of these potential sites and

at the same time to reduce the number of alternatives warranting more detailed study. Relevant cost data are summarized in the table below.

Potential Hydroelectric Generation Site Data

River	Site	Installed Capacity (kW)	Project Cost (1) ($ millions)	Cost per kW ($)
Island Lake	Bad Rapids	8,200	39.13	4772
Island Lake	Kanuchuanus #1	7,000	32.14	4592
Island Lake	Kanuchuanus #2	6,800	31.45	4625
Kanuchuan	Kanuchuan #1	11,600	45.47	3919
Kanuchuan	Kanuchuan #2	10,300	43.03	4178
Gods River	Gods River #1	7,900	39.44	4992
Gods River	Gods River #2	10,500	46.26	4406

NOTE:

(1) Excluding Interest During Construction.

The result of this preliminary screening and ranking of alternatives was to develop two preliminary sequences of development of the various potential plant sites:

(1) A preliminary sequence based on developing firstly those sites with the least estimated project cost.

(2) A preliminary sequence based on developing firstly those sites with the least estimated project cost per installed kilowatt.

Plant additions were subject to two constraints:

(1) Sites on any river designated as #1 must be developed before sites with the same name and designated #2, and

(2) The Bad Rapids site must be developed before the Kanuchuanus #1 site is developed.

As previously stated, capacity additions were scheduled to meet the peak demand with no reserve capacity allowance.

Analysis of the above preliminary sequences and constraints showed that the least cost preliminary sequence would be one based on firstly developing those sites with the least estimated project cost per installed kilowatt. Only results from this sequence are reported below. The least cost sequence is shown in Table 7-1 (Appendix A).

As described in Section 6, various sizes and types of thermal generation were considered. Based on the forecasted demand and growth in demand for the communities, unit sizes of 5,000 kW each appears to be most appropriate. A review of the different types of units, both conventional and non conventional, suggests that the only ones likely to be economically viable are low-speed diesel units and steam electric generating units fueled with biomass. Table 7-2 (Appendix A) illustrates a sequence of thermal additions required to meet the forecasted load.

The capital costs for each alternative are estimated to be:

Alternative/Item	Construction Period	Cost at Commissioning (1983 Dollars x 10^3) 4% AFDC	6% AFDC	8% AFDC
Central System Supply Alternative				
Transmission Line	1987-1987 (1 year)	12,470.	12,950.	13,440.
Transmission Grid	1987-1989 (2 years	25,110.	25,550.	25,990.
Local Hydro Supply Alternative				
Transmission Grid	1987-1989 (2 years)	20,330.	20,740.	21,160.
Kanuchuan #1	1987-1989 (3 years)	47,560.	48,610.	49,660.
Kanuchuan #2	1991-1993 (3 years)	44,890.	45,820.	46,750.
Bad Rapids	2009-2011 (3 years)	40,620.	41,370.	42,110.

Local Thermal Supply Alternative - Biomass

Transmission Gird	1987-1989 (3 years)	20,330.	20,750.	21,160.
2 x 5000 kW units	1987-1989 (2 years)	28,270.	28,430.	28,600.
1 x 5000 kW unit	1989-1991 (2 years)	14,130.	14,220.	14,300.
1 x 5000 kW unit	1996-1998 (2 years)	14,130.	14,220.	14,300.
1 x 5000 kW unit	2000-2008 (2 years)	14,130.	14,220.	14,300.

Local Thermal Supply Alternative - Diesel

Transmission Grid	1987-1989 (3 years)	20,330.	20,750.	21,160.
2 x 5000 kW units	1987-1989 (2 years)	11,630.	11,700.	11,770.
1 x 5000 kW unit	1989-1991 (2 years)	5,810.	5,850.	5,880.
1 x 5000 kW unit	1996-1998 (2 years)	5,810.	5,850.	5,880.
1 x 5000 kW unit	2006-2008 (2 years)	5,510.	5,850.	5,880.

NOTE: AFDC - Allowance for Funds Used During Construction (IDC)

The costs shown in the table above for the transmission grid connecting the communities are different for each alternative. This is the result of the different design details.

Annual fixed charges (return of and on capital) are calculated by multiplying the estimated cost at commissioning by the fixed charge rates, previously listed herein and the charges are shown below:

	Total Annual Fixed Charges 1983 dollars x 10^3		
Alternative/Years	at 4%	at 6%	at 8%
Central System Supply			
1990-onward	2,080.	2,720.	3,440.
Local Hydro Supply Alternative			
1990-1993	3,230.	4,490.	5,880.
1994-2011	5,170.	7,300.	9,640.
2012-onward	6,920.	9,840.	13,030.

Local Thermal Supply Alternative - Biomass			
1990-1991	2,815.	3,575.	4,421.
1992-1998	3,632.	4,609.	5,691.
1999-2008	4,449.	5,642.	6,961.
2009-onward	5,266.	6,675.	8,231.
Local Thermal Supply Alternative - Diesels			
1990-1991	1,924.	2,425.	2,983.
1992-1998	2,296.	2,883.	3,533.
1999-2008	2,668.	3,341.	4,084.
2009-onward	3,040.	3,798.	4,635.

7.4 Operating Costs

Under the Local Hydro and Thermal Alternatives, operating costs are incurred for the plants in service and the transmission grid, while under the Central System Supply Alternative, there are energy costs associated with the supply of power from the Manitoba Hydro Central System as well as costs of operating both the transmission line and the grid. Distribution costs within the communities are common to both alternatives and therefore were not considered in the comparison.

Operating and maintenance costs vary from system to system and depend on many factors including severity of use, severity of environment, experience and training of operating and maintenance staff, and the policies of the utility regarding repairs and replacement of units and components. However, in a study such as this the most important aspect with respect to operating and maintenance costs is that any assumptions made must be consistent for all alternatives. Since the thermal alternatives are more complex, the assumptions made are shown explicitly in Section 6. On a basis consistent

with those assumptions, the following assumptions are made for the other alternatives.

Hydro-electric Plant	0.8% of capital cost
Transmission Line	1.0% of capital cost
Transmission Grid	1.0% of capital cost

These assumptions cover operation, maintenance, administration and general expense, interim replacement and insurance. On the above basis, the annual costs (excluding fixed charges on capital) would be as follows:

	Operating and Maintenance Cost (1983 dollars x 10^3)		
Alternative/Facility	4% AFDC	6% AFDC	8% AFDC
Central System Supply Alternative			
Transmission Line	$120.	$130.	$130.
Transmission Grid	250.	260.	260.
Local Hydro Supply Alternative			
Transmission Grid	$200.	$210.	$210.
Kanuchuan #1	380.	390.	400.
Kanuchuan #2	360.	370.	370.
Bad Rapids	320.	330.	340.
Local Thermal Alternative - Biomass			
Transmission Grid	200.	210.	210.
Units 1 and 2	1,053.	1,054.	1,056.
Unit 3	211.	212.	213.
Unit 4	526.	527.	528.
Unit 5	141.	142.	143.
Local Thermal Alternative - Diesels			
Transmission Grid	200.	210.	210.
Units 1 and 2	554.	555.	555.
Unit 3	102.	102.	102.
Unit 4	277.	277.	277.
Unit 5	67.	67.	67.

Again, the costs shown for the transmission grid connecting the communities involved are different for each alternative as a result of the different design details considered for each alternative.

Information obtained from Manitoba Hydro indicates that the current cost of energy at the Kelsey station bus is 15.8 mills per kWh. This figure was used throughout the forecast period with no real escalation applied for the purposes of this analysis. A sensitivity analysis was performed to assess the impact of the cost of energy rising at a rate higher than overall escalation. Energy losses of 3.5% were included in the analysis to account for transmission line losses from Kelsey to the local grid. Transmission losses within the local grid were considered to be common to each alternative. The annual cost of energy utilized in the forecast was calculated as follows:

Energy Sales Forecast (kWh) x 1.035 x $0.0158. per kWh (1983 dollars)

7.5 Comparison of Alternatives

The alternatives were compared by calculating the present worth at January 1, 1989 of all capital, operating, maintenance, and fuel costs not common to each alternative over the period to 2015. The effect of differing service lives is accounted for by converting the capital costs of each facility into equivalent annual costs over its economic life. Such an approach implies that each facility will be replaced, every time it reaches the end of its economic life, by an equivalent facility at the same cost. Discounting

these annual fixed charges over a specific number of years implies that the value of an asset remaining at the end of the period is taken account of in the form of a credit against the total cost of the facility. The results of the comparison are summarized in Table 7-3. These present worth figures are for relative comparison purposes only. They cannot be used to calculate the price of energy to the customer.

At each of the three discount rates used, the Central System Supply Alternative is the most economic by a wide margin. Among the local supply alternatives, the hydro and the diesels are virtually equal and minor changes in any of the assumptions could change their ranking. The biomass alternative is much more costly than either of the two other local alternatives; only major changes in some of the assumptions could cause a change in the ranking. For instance, if it was assumed that the cost of the fuel supply for the biomass alternative were one-tenth of the level originally assumed (i.e. $2.50 per tonne instead of $25.00 per tonne), then the biomass alternative would become competitive with the other local supply alternatives.

The sensitivity of the comparison between the central system supply alternative and the local supply alternatives was checked by calculating the rate at which energy costs would have to increase in real terms in order to make the alternatives equal. Using a six per cent discount rate, it can be shown that energy costs would have to increase by an average of 9.1% per year above the general inflation rate beginning in 1985 in order for the two alternatives to be equivalent to each other in terms of total costs. At discount rates of 4% and 8%, the real rate of growth of energy costs would have to be 7.0% and 11.1%, respectively.

Table 7-3

Comparison of Alternatives
Present Value as of January, 1989
Millions of Dollars at 1983 Price Levels

Alternative/Item	Present Value at Discount Rates 4%	6%	8%
Central System Supply Alternative			
Fixed Charges - transmission line	9.68	10.55	11.31
- transmission grid	22.28	22.82	23.12
Operation and maintenance - line	1.84	1.59	1.30
- grid	3.84	3.19	2.60
Energy Costs	14.28	11.00	8.68
Total	51.92	49.15	47.01
Local Hydro Supply Alternative			
Fixed Charges - hydroelectric plants	57.12	64.15	68.05
- transmission grid	18.13	18.52	18.82
Operation and Maintenance - plants	10.59	8.78	6.76
- grid	3.07	2.58	2.10
Total	88.91	94.03	95.73
Local Thermal Supply Alternative - Biomass			
Fixed Charges - generation plant	45.15	44.07	42.83
- transmission grid	18.13	18.52	18.82
Operation and Maintenance - plant	23.75	18.50	14.74
- grid	3.07	2.58	2.10
- variable	1.99	1.53	1.21
Fuel Costs	61.29	47.22	37.24
Total	153.38	132.42	116.94
Local Thermal Supply Alternative - Diesels			
Fixed Charges - generating plant	20.56	19.52	18.58
- transmission grid	18.13	18.52	18.82
Operation and Maintenance - plant	12.35	9.62	7.66
- grid	3.07	2.58	2.10
- variable	8.25	6.36	5.02
Fuel costs	55.93	43.09	33.99
Total	118.29	99.69	86.17

Note: The above present value figures take account of comparative system costs only during the period up to year 2015. Since all costs are not included, the above figures are for relative comparison purposes only, and cannot be used to calculate the price of energy to the customer.

7.6 Conclusion

Thus under all sensitivity analysis considered, the Central System Supply Alternative remains the most economic.

8. SOCIO-ECONOMIC IMPACTS

A preliminary socio-economic assessment was undertaken of the impacts of Central Supply System Alternative A. As it appears that this alternative is the least cost system and is thus the most probable course of action, it was selected as the base case on which to estimate employment, income, and other impacts of transmission line clearing, construction, and operation. Should the small local hydro generation alternative be adopted, many of the same transmission line impacts would still be experienced, except that the construction effects of the transmission line from Kelsey to Oxford House would be replaced by site-specific construction effects of the various generating plants to be constructed.

In addition to construction impacts, we have looked briefly at the possible impacts of supplying unrestricted electric power to the communities. These consequences are common to any supply alternative that may be implemented.

8.1 Wage Employment, Income and Contract Opportunities

For those local residents who desire and seek wage employment, upgrading of the electrification system of the North Central communities offers substantial work and income opportunities.

The following Table 8-1 is an estimate of the labour force requirements for skilled and unskilled workers for each activity, location, and work

Table 8-1

Estimated Work Force Requirements

	Activity	Period (# months)	Skilled (jobs)		Skilled (person-months)	Unskilled (jobs)		Unskilled (person-months)
1.	**Right-of-Way Clearing**							
Yr. 1	Kelsey - Oxford House (160 km)	8	x 10	=	80	x 50	=	400
	Oxford House - Gods L. (75 km)	4	x 10	=	40	x 50	=	200
Yr. 2	Gods L. - Garden Hill (90 km)	5	x 10	=	50	x 50	=	250
	Gods L. - Red Sucker (70 km)	4	x 10	=	40	x 50	=	200
Yr. 3	Gods L. - Gods R. (67 km)	3	x 10	=	30	x 50	=	150
	Garden Hill - St. Theresa Pt. (41 km)	2	x 10	=	20	x 50	=	100
	Subtotal				260			1300
2.	**Transmission Line Construction**							
Yr. 1	Kelsey-Oxford House	6	x 48	=	288	x 50	=	300
	Oxford House-Gods L.	3	x 48	=	144	x 50	=	150
Yr. 2	Gods L. - Garden Hill	4	x 48	=	192	x 50	=	200
	Gods L. - Red sucker	3	x 48	=	144	x 50	=	150
Yr. 3	Gods L - Gods R.	3	x 48	=	144	x 50	=	150
	Garden Hill - Waasagomach (32 km)	1	x 48	=	48	x 50	=	50
	Waasagomach - St. Theresa Pt. (9 km)	1	x 48	=	48	x 50	=	50
	Subtotal				1008			1050
3.	**Transformer Station Construction**							
	Kelsey Extension	3	x 4	=	12	x 12	=	36
Yr. 1	Oxford House	2	x 4	=	8	x 12	=	24
	Gods Lake Narrows	2	x 4	=	8	x 12	=	24
Yr. 2	Garden Hill	3	x 4	=	12	x 12	=	36
	Subtotal				40			120
4.	**Distribution System Conversion**							
	Garden Hill	3	x 3	=	9	x 6		18
Yr. 2	Gods Lake Narrows	2	x 3	=	6	x 6		12
	Gods River	1	x 3	=	3	x 6		6
	Red Sucker Lake	1	x 3	=	3	x 6		6
Yr. 3	St. Theresa Pt.	2	x 3	=	6	x 6		12
	Waasagomach	2	x 3	=	6	x 6		12
	Subtotal				33			66

Table 8-1 (Continued)

5. Construction Camps Personnel								
Yr. 1	Kelsey - Oxford House	6	x 10	=	60	x 20	=	120
	Oxford House - Gods L.	3	x 10	=	30	x 20	=	60
Yr. 2	Gods L. - Garden Hill	4	x 10	=	40	x 20	=	80
	Gods L. - Red Sucker	3	x 10	=	30	x 20	=	60
	Gods L - Gods R.	3	x 10	=	30	x 20	=	60
Yr. 3	Garden Hill - Waasagomach	1	x 10	=	10	x 20	=	20
	Waasagomach - St. Theresa Pt.	1	x 10	=	10	x 20	=	20
	Subtotal				210			420
6. Staging Area Personnel								
	Kelsey	12	x 1	=	12	x 4	=	48
	Oxford House	12	x 1	=	12	x 4	=	48
	Gods Lake	12	x 1	=	12	x 4	=	48
	Garden Hill	12	x 1	=	12	x 4	=	48
	Waasagomach	12	x 1	=	12	x 4	=	48
	Subtotal				60			240

7. Summary Totals

Skilled Employment (33.5%)	1611	3196
Unskilled Employment (66.5%)		
Total Employment from Project	4807	
Community Skilled Employment (7.5%)	121	3196
Community Unskilled Employment (100%)		
Total Community Employment	3317	

phase during the projected three-year construction period. Approximately 4800 person-months of work will be generated by construction of the project. Nearly two-thirds (3200 person-months) of this work opportunity will be for unskilled workers. Assuming that all unskilled workers will be hired from the local communities, and that 7.5% of the skilled personnel, i.e. 120 person-months, will be obtained from the local labour pool, a total of 3320 person-months of work will be available to residents of the North Central communities. Should local workers possess the experience to fill a larger number of skilled positions than estimated, or should sufficient skill upgrading and training be undertaken by them prior to start-up, the number of skilled jobs occupied by local residents will be increased beyond the estimated 121 person-months of skilled employment.

Assuming an average work period per job of four months, about 830 unskilled (four-month) jobs and about 30 skilled (four-month) jobs will be available to local residents over the three-year construction period.

Employment benefits will be distributed over the course of three years of construction, with the greatest amount of work available in Year 1 and the least in Year 3. As progress of the construction operation is from north to south, the community-specific benefits will follow the same pattern. That is, Oxford House will experience benefits in Year 1 and Waasagomach-St. Theresa Point in Year 3.

Those communities situated at the ends of the longest or most numerous line segments will generally obtain the greatest benefits.

Total cost of the project including labour and materials over the three-year construction period is estimated to be $35.5 million (1983 $). Approximately 44%, or $15.7 million, is anticipated in Year 1, 36% or $12.8 million in Year 2, and 20% or $7 million in Year 3.

Detailed cost breakdowns of labour and materials estimates, or of wage rates and labour costs within the labour component, are not available at this time. At an assumed split of 40% for labour and 60% for materials (normal for this type of northern transmission project), the estimated costs for the project per construction year (1983 $ x 000's) break down as follows:

	Total	Labour	Materials
Year 1	$15,680	$ 6,272	$ 9,408
Year 2	12,792	5,117	7,675
Year 3	7,020	2,808	4,212
	$35,492	$14,197	$21,295

Thus, approximately $14.2 million in construction wages and labour-related expenses are anticipated to be spent on the project. Unskilled jobs pay an average of $8,333 each for four months ($25,000 per annum); thus, about $6.9 million will be paid to local construction workers (unskilled). Skilled jobs are estimated to pay about $18,666 each for four months ($56,000 per annum); for 30 skilled positions, approximately $600,000 will accrue to local workers (skilled).

The total income benefits from employment of local workers on the construction of the project are estimated, therefore, to be about $7.5 million spread over a three-year period. Approximately $3.3 million would be derived in Year 1, $2.7 million in Year 2, and $1.5 million in Year 3.

The communities could realize additional income benefits as a result of spending by outside construction workers in the communities. Local residents could obtain cash supplements to their normal incomes by providing leisure-time goods and services to workers, such as through guiding, equipment supply and rental, transportation services and vehicle rental, and so on. These potential benefits would depend, of course, on the communities' policies with regard to the extent to which they desire contact with the external labour force attracted by the project.

In addition to the potential employment and income benefits to be derived from transmission line construction, the possibility also exists for some business and contracting opportunities for local suppliers of certain goods and services. Assuming a construction management policy of maximizing local purchase and procurement, the Bands or individual entrepreneurs could possibly supply the Project with borrow materials, trailers or mobile homes (which might then be converted to resident housing after construction), food and other supplies, and catering and laundry services. A local organization could also provide recruitment, screening, training, transportation, coordination, and administrative services with respect to supplying the project with local workers on a contract or fee-for-service basis. Additional opportunities might be identified in the pre-construction planning phases of the project.

Employment, income, and contract opportunities during the operations and maintenance period are considered to be virtually non-existent for local residents. At most, local inspection personnel may be employed on an ad hoc basis once the system connection is installed.

8.2 Housing and Community Facilities

Each reserve has a shortage of housing; no excess capacity exists to provide shelter for outside construction workers. The community of Island Lake has a number of public overnight accommodation units. A lodge and five cabins, with a total of 26 beds, are located in Gods Lake Narrows. These units might be available to outside construction workers during the winter season, but typically not during summer.

The project-generated demand for housing within any of the communities will only be felt during a two- to four-month period in the summer. At these times, when transformer station construction and distribution system conversion activities are to be carried out, up to approximately seven outside workers are likely to require housing in or near the communities, especially Oxford House, Gods Lake Narrows, and Garden Hill. Housing during these periods could be provided in one of three ways, or a combination of them. The choice would be determined by project acceptability and by community need and preference.

One method would be to locate a temporary camp for workers on the outskirts of each affected community. Once work is completed, the camp would be dismantled and removed.

A second method would be to construct a small motel or public accommodation facility. If such a facility is likely to be generally viable in a particular community after completion of the project, in terms of on-

going government, service, tourist, and/or business clientele, then its initial profitability could be ensured by regular use by construction and supervisory personnel.

The third method is to construct a certain number of new, fully-serviced homes in each community. These houses would be built to INAC/CMHC specifications, according to Band wishes and by Band construction workers. The units would be built during the year preceding construction activity in each community. The homes would be occupied initially by outside workers during the summer construction period on a rental basis, and then be turned over to reserve families as construction activities are completed. In this way, the project could provide both for the needs of its skilled employees in the short term and benefit the long term needs of the local residents. A significant benefit could be provided, therefore, over and above normal permanent house production in the communities so as to alleviate the housing shortage and overcrowded conditions existing on the reserves.

During the winter periods of right-of-way clearing and transmission line construction, it is expected that, in all cases, fully self-contained, portable, construction camps will be employed to house all workers outside the communities. Typically, two 100-man camps moving along the line from each end of a line segment would be employed. These camps will have and carry with them their own trailers, diesel power plants, fuel supplies, sanitary facilities, and cooking/eating facilities. They would not exert any substantial pressure on nearby communities' existing housing, grocery, service station, or waste disposal facilities. On the contrary, trailers, surplus mate-

rials, and equipment in fact could be sold and/or leased to the bands or local businesses upon completion of the project. In some cases, the project's need for additional waste disposal sites, water, food supplies, fuel, etc. may provide further opportunities for improving and/or supporting existing community facilities.

The project may have an adverse impact on the community's recreational facilities and resources. Construction workers are likely to travel to communities for leisure-time and recreational activities placing possibly high demands on arenas, rinks, halls, and eating/drinking establishments. If permitted, workers will also put pressure on the area's hunting and sport fishing resources. On the other hand, this activity may also produce some positive benefits to the community in terms of spending by outside workers at local lodges, bars, restaurants, stores, service stations, and with individual Band members.

8.3 Roads and Traffic Movements

As roads within the communities are generally unimproved, and particularly as the heavy construction activity is assumed to take place almost entirely during the winter, no adverse effects on community roads are anticipated. On the other hand, to support some of the heavy equipment being delivered and transported to the line, as well as the equipment required during projected summer construction of the transformer stations, local roads may require upgrading and repair for project purposes. A positive benefit in terms of local road improvement may be obtained, therefore, as a result of the construction project.

The communities will experience, of course, a degree of disturbance during construction periods. The much increased level of equipment and personnel movements will increase the noise, nuisance, dust, mud, and risk to which local residents are exposed during both the initial winter staging and line construction phases and the summer station construction and distribution conversion periods.

Continuation and possibly improvement of winter road construction from the south could be crucial to transmission line construction. No all-weather roads exist to any community. Once the line is completed, however, the need and justification for winter roads in the area may be substantially weakened. Elimination of the need to generate power via the existing diesel systems will substantially reduce the need for diesel fuel and, consequently, one of the primary needs for winter road construction. Presently, diesel fuel represents about 60% of all tonnage hauled into the area by winter roads. As freight movements are reduced and because the transport cost savings for other consumer goods are much less than those for fuel, the economic viability of a winter supply road becomes questionable. The communities could then be faced with the choice of transporting foodstuffs and other goods by air or continuing to build and haul over the snow roads during the winter season. Air transport would likely increase the cost of some goods in the communities, assuming no government subsidy for air transport equivalent to that received for winter road construction. Cessation of winter road construction would also eliminate a source of winter employment for local residents.

8.4 Education and Recreation

No impact on community schools is anticipated from transmission line construction, with the possible exception of using school space for intensive training programs prior to construction. Should a heavy work and life skills training commitment be made, the local schools and Band offices may well serve as the foci of that activity. This can be looked upon as a positive benefit.

Once unrestricted electric service is provided in the general community, some increased opportunities for curriculum development and home-based support for education may emerge. In those cases where new schools or facility improvements should be required, the availability of unlimited power increases the choices to be made regarding lighting, equipment, and heating.

Similarly, provision of full-service power will expand recreational possibilities, making perhaps more feasible the development of arenas, rinks, and workshops.

8.5 Health and Nutrition

Construction camps typically maintain first-aid stations for immediate treatment of accidental injuries and minor illness. The project could make demands on the better-equipped nursing stations in the communities of Oxford House, Gods Lake Narrows, and Garden Hill. For more serious injuries or illness, workers are likely to be transported to Thompson or Winnipeg.

The project is not likely to impact in any significant way on the health facilities or services of the communities, except in the event of a major accident and/or illness among both construction workers and local residents. In the event of overload on medical staff and treatment facilities, a contingency evacuation plan should be in readiness and implemented.

Enhanced electrification will yield the theoretical possibility of improving the general health, diet, and nutritional value of food consumed by local residents. Operation of better food storage and cooking appliances will be possible by an unrestricted power supply. This would enable residents to freeze country food and game on a long-term basis, thus providing for both improved nutritional quality in their diets and lower food purchase costs.

Whether residents will in fact obtain these health and nutritional benefits will depend to a large degree on their income stream, spending choices, and knowledge. As the Churchill and Nelson River Study Board report suggested, Indian people need to be educated in the areas of better nutrition and improved freezing/refrigeration/cooking/storage methods for these benefits actually to be achieved.

8.6 Public Safety

While normal precautions are taken and danger notices are posted, the presence of high-voltage transmission lines and tranformer stations poses a safety risk, primarily to children living, playing, or engaged in tradi-

tional activities in their vicinity. This risk in turn places an unavoidable burden of concern on parents. A program of information and warning, in addition to erection of the usual physical barriers and design precautions, is needed to reduce these risks to a minimum.

As transmission line construction brings with it a number of non-local workers, the potential exists for conflict with local residents. This potential would be mitigated somewhat by the development of isolated, completely self-contained construction work camps and by a project policy of restricting worker access to local communities.

It is generally inevitable, however, that construction workers will enter local communities during off-hours to frequent restaurants, community halls, recreation facilities, and other public places. In cases of alcohol abuse, intra- and inter-community rivalries, or racially prejudiced attitudes, the interaction between outside workers and local residents can become antagonistic and, in severe cases, aggressive or violent.

It will be necessary, therefore, for the law enforcement and community worker capacities in communities impacted by construction to be brought to levels sufficient to prevent conflicts if possible, or to take quick action as soon as conflicts emerge. Where normal community resources are insufficient for these tasks, they will require temporary staff augmentation and upgrading in each community during construction impact periods. These demands will probably require, therefore, the expenditure of supplementary public funds.

8.7 Traditional Activities

Transmission lines generally have mixed impacts during construction periods and positive longer-term benefits to local residents engaged in traditional hunting and trapping activities.

The line rights-of-way provide improved access to both existing and previously inaccessible harvesting areas. As construction displaces animals in the short-term, harvesters will be affected adversely during these periods. Adequate compensation can be provided for such temporary damages. On the other hand, in the post-construction period, hunters and trappers will benefit from improved and more economic access to harvest areas and from improved habitat along the line's "edge" for a variety of harvested species.

It is possible, therefore, for the transmission line to be responsible indirectly for improving the supply of country food to community residents, and to lower the harvesting costs of country food. Similarly, trappers may also benefit from improved furbearer populations, reduced costs of production, and higher incomes due to the post-construction benefits of a cleared right-of-way.

8.8 Cost of Living

According to Manitoba Hydro's 1983 billings for the seven communities, there are approximately 1013 residences currently on restricted 15 amp, 110/220 volt service. Of the 1013 residential services, Indian Affairs per-

sonnel estimate that over 90 percent of the residences are sized to accept 100 amp service, with the remainder sized for only 15 amp service.

There are an additional 340 non-residential services, including commercial buildings, federal and provincial government buildings, service buildings, and associated residences all of which have greater than 15 amp service with no restrictions on power used. For these 340 services, the clients are charged full rates based on an energy rate, a generation cost and usage.

When full unrestricted electrical service is available, the residents of all the communities will have the opportunity to convert their homes to accept the unrestricted electrical supply. The cost of upgrading a community distribution system is usually borne by Manitoba Hydro and thus does not affect the cost to the individual householder irrespective of the type of service with which the individual residence is equipped. Subsequent to the connection of a community to the central system supply, should a householder decide to upgrade the house wiring and service entrance of the household, Manitoba Hydro will, at no cost to the resident, upgrade the service drop to the house if required. However, the cost of upgrading the household wiring, service entrance, and meter socket is normally the responsibility of the householder.

Thus, there will be a conversion cost for any householder who wants to have his/her electrical supply upgraded. The approximate costs for three levels of conversion (in 1983 dollars for labour, wiring, and materials) are as follows:

Level 1. Upgrading a residence with an existing 15 amp service entrance to a 100 amp service entrance. $1,000

This would apply to less than 10 percent of total households

Level 2. Upgrading a residence with a 100 amp service entrance, but equipped with 15 amp main circuit breakers, to full 100 amp service. $100

This would involve changing the main breaker and upgrading any wiring which does not conform with the electrical code. It is estimated that this cost would probably be applicable to virtually all households.

Level 3. Upgrading a residence with an existing 100 amp service drop and service entrance and 15 amp main breakers to 200 amp all electric service (to provide for electric heating). $2,500

This would include a new service drop, a new distribution panel, additional interior wiring, and permanently wired heaters. This cost would apply to all householders desiring to heat their existing homes electrically.

In all cases, the actual costs of conversion would depend on the level of upgrading chosen and the repairs required in each existing residence. Upgrading of service to Levels 1 and 2 for institutional and commercial customers would be unlikely, as most of these customers are now on unrestricted service. Level 3 all electric service, however, would require extra costs for commercial and institutional buildings presently not using electric space heating.

Due to the elimination of restrictions on the use of electricity, and after the capital costs of conversion are paid, there will be a predictable continuing cost increase to community householders during the first eight years due to their increased use of electricity. Based on Manitoba Hydro

statistical data, these increases are assumed to be comparable to other northern communities, e.g. Norway House, Nelson House, and Cross Lake, which converted from restricted service to all-electric service. The average annual increase in the use of electricity by residential customers in the communities of Nelson House and Norway House during the eight years subsequent to the elimination of restrictions was 10% per year. Manitoba Hydro has assumed that the corresponding annual average increase in the North Central communities will be 13% for a period of eight years, with the increase in the first full year of unlimited power being about 40%. This large increase in consumption during the initial eight-year period is primarily due to two reasons: householders leave appliances plugged in rather than being forced to unplug one appliance to use another; and householders acquire more appliances and ones with heavier power requirements. After about eight years, the power consumption increases become relatively stable and approximate very closely the rate of increase applicable provincially which is about 2 to 3% per year.

The average cost of electricity per residential service in all seven communities for a 12-month period in 1982/83 was about $28.50 per month or $340 for the year. Average consumption was 470 KWh/month or 5640 KWh/year per household.

Consumption for households that do not convert to electric space heating will likely rise on average over the first eight years of unrestricted service to approximately twice its current level, i.e. 960 KWh/month or 11,500 KWh/year. The actual cost to residents will also rise by a factor

of two since the rates for unrestricted central system supply for rural areas are the same regardless of method of supply (i.e. hydro or diesel). Therefore, once unrestricted service is available to the seven communities, by the end of the eighth year the average annual electric cost (in 1983 dollars and at 1983 rates) to households using electricity for light and power purposes (Level 2) will rise to $505, or $42 per month. In addition to the impact of this cost increase of $160 per year, some households may experience cash flow difficulties. Under existing conditions, a householder's average monthly payment is very close to the annual average, i.e. the maximum is about $30/month and the minimum is about $20/month. With unrestricted service the average winter payment becomes considerably higher than the average summer payment, in contrast to the existing almost flat monthly cost.

For those households converting to all-electric space heating (i.e. Level 3), further substantial cost increases, over and above the cost of Level 2 service, in the average annual electric bill will be incurred. Consumption rises to an average of 1960 KWh per month or 23,500 KWh per year. Level 3 consumers can thus expect to pay an average cost (in 1983 dollars and at 1983 rates) of $840 per year, or $70 per month. The addition of electric heat, therefore, will increase the average hydro bill by about 75% over the unrestricted normal 100 amp service. It should be noted, of course, that hydro rates are likely to increase at least at the general rate of inflation, making the real cost of electricity to the householder higher than the costs quoted above in constant 1983 dollars and at current rates.

The load projections in this report assume that once unrestricted service is provided to the communities, all newly constructed housing will be equipped for 200 amp service. This does not mean, however, that future residents of the new houses will in fact be required to use the full capacity of the built-in 200 amp service for heating purposes.

Considering the high incremental cost of heating electrically, it can be expected that many householders will opt not to convert to Level 3 all-electric service and thus continue to heat their homes with wood fuel. Indeed, if the evidence from Easterville rather than that of Norway House, Cross Lake, and Nelson House is typical of the situation, nearly 90% of all hook-ups to land line central system power may be for light and power only, with slightly more than 10% of the households equipped for electric heating. Thus for the great majority of households, their initial conversion costs could amount to $100, and their average annual hydro billings would increase by $165 from about $340 to $505 (in 1983 dollars and 1983 rates).

For those wishing Level 3 service for heating purposes, the initial conversion cost will be about $2,500, and the average annual hydro cost would increase by $500, from about $340 to $840. These increases over existing costs could constitute considerable reductions in disposable income available for other purposes, expecially where average per capita household incomes in the communities remain low ($3,100 in 1974).

8.9 Economic Benefits and Economic Development

Within the communities, the economic benefits of higher levels of electrification are of two types. For "productive" uses, i.e. for business and industry, electricity is often cheaper and/or more efficient for purposes of motive power, refrigeration, and sometimes heat. This enables the producers to increase profits and/or lower prices by cutting costs and expanding output.

For domestic or household uses, the economic benefits are the householders' valuation of a superior quality of lighting and small appliance use, and the capability of simultaneously using power tools, fans, refrigerators, freezers, stoves, washers, driers, and supplementary heaters.

A third type of benefit, sometimes attributed to full electrification of remote communities, is the ability to stem the tide of outmigration from the reserves. Such a benefit is unlikely, however:

> "The importance of village electrification as a means of encouraging people to live in the villages rather than the cities is also often cited as an economic benefit. Although people often migrate from the rural areas to the villages, there is no evidence to show that electrification plays an important role in reducing migration to large cities". (Rural Electrification: A World Bank Paper, October 1975, p. 7).

Third world experience has indicated "that electricity has had a surprisingly small direct effect on development" (G. Wilson, Owen Falls: Electricity in a Developing Country. East African Publishing House, Kampala, 1967:102). The only notable examples of a direct causal link are high

power-consumption industries, such as mine smelters. But the "provision of power for a few industries has...had very little cumulative effect", and "although many [small] firms used public electricity it had little effect on their productivity and in some cases actually caused a needless increase in their costs" (p. 103).

In the context of north central Manitoba, the right-of-way created by transmission line construction can improve access to commercially exploitable resources, such as merchantable timber stands, suspected or proven mineral deposits, and lakes and rivers with commercial fishing potential. Transmission line route selection can be very important, therefore, to the future development of area resources by local communities. This can be particularly crucial for the development of the considerable gold mining and timber potential existing in the Island Lake area.

Similarly, should economic development projects which involve a major use of electric power be sited near the transmission line rights-of-way, thereby enhancing access to them, then the feasibility, costs of production, and profitability of these plants could be improved.

Thus, the routing and characteristics of the line can be a critical determinant of the viability and feasibility of potential resource development projects in the Island Lake area.

Prospects for future recreational developments could also be enhanced by favourable transmission line routing. Once agan, the benefits of

improved access and unrestricted economical power could improve the viability of new or existing lodges. On the other hand, the main line could adversely affect lodge operations if located too closely or too visibly to areas of high aesthetic value.

In summary, the variety of economic development opportunities, either new or existing, that might be aided by electrification improvements are many, and include mines, fish processing and freezing plants, saw mills, workshops and manufacturing plants, warehouses, equipment and vehicle repair shops, machine shops, motels and restaurants, lodges and camps, radio and television stations, greenhouses, canneries, local building materials, suppliers, and construction services.

8.10 Lifestyle

Virtually no research has been performed on the subject of social and lifestyle impacts of second-stage electrification per se on remote, northern native communities. Furthermore, the limitations on this study have made it impossible to do the primary research necessary to obtain the detailed baseline information that would be needed to assess the impact of full electric service on the lifestyle of Island Lake area residents.

There are several general possibilities, however:

1. That the improvement of electric service will have no detectable effect, as the major impacts of electrification on lifestyle have already been incurred years ago with the provision of diesel-generated power in the communities.

2. That improved electrification will reinforce and speed up the general tendency toward a more sedentary and passive lifestyle made more comfortable by the ability to operate more labour saving household appliances, and possibly to avoid gathering of a wood fuel supply.

3. That the economic and industrial development facilitated by electrification improvements will, more than any other factor, result in a major shift from a predominantly traditional, independent, natural resource-based lifestyle to a more technologically-dependent, wage-based economic lifestyle, accompanied by an accentuated shift from production of goods to production of services.

Literature in the field of socio-economic impacts offers no guides as to the probable result among Island Lake residents.

We believe, however, that the first possibility of no significant lifestyle impact is the most likely result of the project. It is only in the event of major economic and industrial development posited in possibility number three above that major lifestyle change is likely to occur. It is that development, perhaps faciliated by electrification, which in turn would push the people in the North Central area toward the third possibility--a major change in lifestyle.

9. ENVIRONMENTAL IMPACTS

The primary environmental impacts of two potential alternatives are summarized in the following discussion. A more detailed analysis is included in Appendix B.

9.1 Central System Supply Alternative

An overview environmental impact assessment was carried out on the clearing of a right-of-way, and construction and operation of a potential transmission line connection from Manitoba Hydro's Kelsey generating station to a transmission line grid which would supply electricity to the seven communities. Throughout this assessment, the term "construction" includes clearing and any other line-associated activities. While the overview relates directly to the Kelsey Station tie, the impacts for the different routings considered would on the whole be similar but not identical.

Summer construction of transmission lines is not practical. If done, however, summer construction would pose such potential impacts as siltation of fish spawning areas at stream crossings, disturbance or destruction of archaeological resources, and loss of timber from accidental forest fires. All impacts theoretically could be mitigated through defined procedures. Risks of damage are lower if construction is carried out in the winter season, as recommended.

The most serious impact of winter line construction would be on trapping. Construction would disturb most wildlife along the right-of-way causing animals to move out of the area. This will result in a decreased fur harvest by trappers along the right-of-way. The effect would only be for the winter seasons in which construction actually took place within a trapline area. Damage could be compensated for by payments equal to the value of lost production to those trappers affected.

After the initial negative impact of winter line construction, trapping will benefit in the long term as a result of improved access to traplines and from the "edge effect" of clearing. This effect will create some new wildlife habitats adjacent to the right-of-way. For example, habitat will be created for hares which will attract furbearing predators such as fox and lynx.

Ungulates such as moose will be impacted through increased hunting by Treaty Indians as a result of improved access to heretofore relatively inaccessible areas. This constitutes a long-term, permanent impact. Although the right-of-way will pass through ungulate habitat, the extent of that habitat or area of impact is not known at present. Game management techniques may be necessary to mitigate the impacts of Treaty Indian hunting by regulation of sport hunting.

All other resource impacts should be minor, mitigatable, and non-residual.

9.2 Local Hydro Generation Alternative

An environmental overview was carried out to determine the impacts of potential development of small hydroelectric generating stations in the study area. The assessments were made from a review of Manitoba Hydro studies on line routing and small generation site potential, reviews of construction and post-construction reports on the Nelson River to Winnipeg HVDC transmission lines, and on-site investigations carried out on potential small generating stations on Gods River, at Kanuchuan, Kanuchuanus, and Bad Rapids.

The impacts identified for transmission lines are also applicable to small hydro developments since these would require transmission line interconnections as well as connections to all of the communities.

The most serious impact of small hydro-electric generating stations will be their negative effect on brook trout populations in the Gods Lake area by destroying prime brook trout habitat and interfering with fish passage. This will result in a reduction of the brook trout population. This negative impact will also be felt by the lodges which depend on brook trout for attracting their business.

Trappers will be affected by flooding of important furbearer habitat, especially should Gods River Site 2 be developed, but this site would not be developed until the second half of the twenty-first century, if at all. The impact of all other developments on trapping should be minimal. Loss of fur production due to any development would require compensation for those trappers affected.

Heritage resources present some concern, particularly in the vicinity of Kanuchuanus Rapids, where the existence of pictographs has been documented. Even though development would not occur till the middle of the twenty-first century, archaeological investigations will be required at high-potential archaeological sites once areas of possible flooding have been determined.

9.3 Other Alternatives

Preliminary environmental considerations were made for other alternatives. As the study progressed and it became obvious that the alternatives would be rejected, accordingly, environmental assessments were not completed. Some of the data produced to that point, however, are appended (see Appendix C).

9.4 Conclusion

On the basis of potential environmental impacts, the Central System Supply is the preferable alternative since its primary effect would be a relatively low impact on trapping compared to the much more severe impact that local hydro generation would have on brook trout populations. In addition, a high cost of mitigating impacts caused by local hydro generation could be anticipated, judging from compensation claims for other hydro projects in the Province.

The above impact assessment should only be considered as an overview assessment because:

1) there were budget limitations in this study, and

2) once a decision is made to proceed, Manitoba Hydro will have to carry out a detailed environmental impact assessment to the satisfaction of the Manitoba Environmental Assessment Review Agency (MEARA) and other provincial government agencies.

Such a study would have to be carried out and approved by MEARA prior to the commencement of any on-site clearing or construction. The study would determine the precise impact and mitigation required for any resources which would be impacted.

It is estimated that an environmental impact assessment would take up to four months to complete at a cost of approximately $50 thousand. It is also estimated that approval by provincial regulatory agencies would take an additional two months.

10. PUBLIC PARTICIPATION AND RESPONSE

Early in the study, the seven communities were sent newsletters in Cree syllabics and English. TV tapes were prepared in the native languages which described the study and told the residents how they could be involved. The response by the communities was very positive.

Once the study results were known, a TV tape was produced in English (as requested by the Band Chiefs) and was presented in each community. The presentation was followed by a question period in which the Band Chiefs and Mr. Ed Wood, Acting Executive Director of the Island Lake Tribal Council responded to questions by the community residents. In some communities general meetings were held and the presentation was also delivered on local radio. The results of the study were also presented on TV in the form of a summary matrix of Electricity Production Choices.

The responses to the media presentation and public presentation were unanimously in favour of a land line connection to Kelsey generating station and were against local hydro generation. The oustanding concern voiced in the communities was for the protection of their natural resources and therefore rejection of any system that impacted those resources.

11. CONCLUSIONS

The results of this study are depicted in Figure 11-1. The preferred alternative based on construction economics, environmental, and socio-economic criteria is a transmission line connection from Manitoba Hydro's Kelsey Station to the seven North Central communities. In addition to this alternative having the lowest construction cost, the lowest environmental impacts (all of which are mitigatable at a relatively low cost), and high potential socio-economic benefits, it is the preferred alternative of the communities' people.

FIGURE 11-1 ELECTRICITY PRODUCTION CHOICES

METHOD	COST (MILLIONS)	ENVIRONMENTAL CONCERNS	SOCIAL BENEFITS & CONCERNS
TRANSMISSION LINE FROM KELSEY TO 7 COMMUNITIES	$49.2	LOW (TRAPPING)	APPROXIMATELY $7 MILLION FOR JOBS FOR COMMUNITY RESIDENTS
SMALL HYDRO PLANTS AT KANUCHUAN & BAD RAPIDS	$94.0	BROOK TROUT LAKE & RIVER FLOODING	IN EXCESS OF $11 MILLION FOR JOBS FOR COMMUNITY RESIDENTS
MORE DIESEL PLANTS	$99.7	NONE	NO BENEFITS
WOOD BURNING STEAM GENERATORS	$132.4	REJECTED TO COSTLY	
OTHERS: PEAT MOSS STEAM GENERATORS WIND SOLAR WOOD GASIFICATION DUAL ENGINE		ALL REJECTED	

APPENDIX A

TABLES AND FIGURES FOR SECTION 2, 4, 5, AND 7

ISLAND LAKE AREA ENERGY FORECAST 1980/81 TO 2015/16
GARDENHILL ,2.35 PCT POP. GROWTH, 6.85 TO 5.43 PRS PER HOUSE
PLUS:GODS LAKE NARROWS ,2.35 PCT POP. GROWTH,6.986 TO 5.43 PRS PER HOUS
PLUS:GODS RIVER ,2.35 PCT POP. GROWTH,6.44 TO 5.43 PRS PER HOUSE
PLUS:OXFORD HOUSE ,2.35 PCT POP. GROWTH,5.856 TO 5.43 PRS PER HOUSE
PLUS:RED SUCKER LAKE ,2.35 PCT POP. GROWTH,7.32 TO 5.43 PRS PER HOUSE
PLUS:STE THERESA POINT,2.35 PCT POP. GROWTH,8.391 TO 5.43 PRS PER HOUSE
PLUS:WASAGAMACH ,2.35 PCT POP GROWTH ,7.593 TO 5.43 PRS PER HOUSE
CENTRAL SYSTEM SUPPLY
TABLE 2
BASE YEAR 1980

YEAR	ESTIMATED POPUL'N	REQ'D HOUSES	OLD HOUSES	MWH CONSUMP'N OLD HOUSES	NEW HOUSES	MWH CONSUMP'N NEW HOUSES	MWH TOTAL HOUSE CONSUMP'N	MWH ESTIMATED COMMER'L CONSUMP'N	MWH ESTIMATED COMMER'L HEATING	MWH TOTAL COMMER'L + HOUSES	ESTIMATED NO. OF ST LIGHTS	MWH ESTIMATED ST LIGHT CONSUMP'N
1980	6204	893	893	4643	0	0	4643	5745	0	10388	234	172
1981	6328	963	893	4457	70	341	4798	5888	0	10686	269	199
1982	6452	993	893	4881	100	522	5403	6087	0	11490	306	225
1983	6605	1019	893	4452	126	619	5071	6229	0	11300	282	208
1984	6759	1059	893	4452	186	818	5270	6370	0	11640	295	217
1985	6918	1100	893	4452	207	1024	5476	6516	0	11992	308	226
1986	7081	1145	893	4452	252	1253	5705	6667	0	12372	320	235
1987	7246	1191	919	4953	272	1697	6650	6820	283	13753	335	246
1988	7419	1240	941	6030	299	3887	9917	6976	1313	18206	350	257
1989	7592	1289	1019	7669	270	6346	14015	7138	3037	24190	365	268
1990	7770	1343	1019	8516	324	7616	16132	7303	4840	28275	381	281
1991	7953	1465	1019	9637	446	10483	20120	7470	6725	34315	416	306
1992	8140	1498	1019	10872	478	11258	22130	7641	8691	38462	428	313
1993	8331	1534	1019	11698	515	12105	23803	7817	10747	42367	436	320
1994	8526	1570	1019	11926	551	12950	24876	7998	12892	45766	448	330
1995	8727	1608	1019	11926	589	13843	25769	8181	15136	49086	458	335
1996	8933	1646	1019	11926	627	14735	26661	8369	15892	50922	468	344
1997	9143	1683	1019	11926	664	15605	27531	8563	16258	52352	478	352
1998	9356	1722	1019	11926	703	16522	28448	8757	16631	53836	490	360
1999	9577	1763	1019	11926	744	17484	29410	8961	17013	55384	503	369
2000	9803	1805	1019	11926	786	18474	30400	9167	17405	56972	514	378
2001	10032	1849	1019	11926	830	19508	31434	9378	17806	58618	526	386
2002	10268	1892	1019	11926	873	20517	32443	9593	18213	60249	538	396
2003	10510	1937	1019	11926	918	21574	33500	9813	18635	61948	552	407
2004	10758	1982	1019	11926	963	22633	34559	10038	19062	63659	564	414
2005	11008	2027	1019	11926	1008	23690	35616	10271	19501	65388	577	423
2006	11267	2074	1019	11926	1055	24794	36720	10506	19950	67176	590	434
2007	11532	2124	1019	11926	1105	25970	37896	10748	20407	69051	606	446
2008	11803	2173	1019	11926	1154	27121	39047	10996	20878	70921	618	454
2009	12081	2226	1019	11926	1207	28367	40293	11248	21357	72898	634	466
2010	12365	2276	1019	11926	1257	29541	41467	11506	21848	74821	648	476
2011	12655	2331	1019	11926	1312	30834	42760	11770	22350	76880	664	487
2012	12954	2386	1019	11926	1367	32127	44053	12042	22865	78960	679	500
2013	13257	2441	1019	11926	1422	33419	45345	12319	23391	81055	695	511
2014	13568	2499	1019	11926	1480	34782	46708	12603	23928	83239	711	522
2015	13887	2557	1019	11926	1538	36145	48071	12892	24479	85442	728	535

STUDY:ISLKIDED; CALC:CENTRAL; TBL:C1; CASES: GHILL GLN GRIV OXH RSL STP WAS

ISLAND LAKE AREA ENERGY FORECAST 1980/81 TO 2015/16
GARDENHILL ,2.35 PCT POP. GROWTH, 6.85 TO 5.43 PRS PER HOUSE
PLUS:GODS LAKE NARROWS ,2.35 PCT POP. GROWTH,6.986 TO 5.43 PRS PER HOUS
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PLUS:WASAGAMACH ,2.35 PCT POP GROWTH ,7.593 TO 5.43 PRS PER HOUSE
CENTRAL SYSTEM SUPPLY
TABLE 2A
BASE YEAR 1980

YEAR	MWH TOTAL HOUSE CONSUMP'N	FED LIGHTING LOAD MWH	PROV LIGHTING LOAD MWH	OTHER LIGHTING LOAD MWH	FED HEATING LOAD MWH	PROV HEATING LOAD MWH	OTHER HEATING LOAD MWH	MWH TOTAL C + H + S CONSUMP'N	PEAK DEMAND KW
1980	4643	4045	425	1276	0	0	0	10560	2411
1981	4798	4146	435	1307	0	0	0	10885	2485
1982	5403	4285	450	1352	0	0	0	11715	2675
1983	5071	4383	460	1383	0	0	0	11500	2628
1984	5270	4484	470	1414	0	0	0	11657	2708
1985	5476	4587	482	1446	0	0	0	12218	2788
1986	5705	4695	493	1479	0	0	0	12607	2878
1987	6650	4802	505	1515	238	17	28	13999	3377
1988	9917	4912	516	1548	1102	79	131	18483	4987
1989	14015	5025	529	1584	2551	182	304	24456	6980
1990	16132	5142	540	1620	4064	291	483	28556	8149
1991	20120	5258	552	1658	5647	404	672	34621	9880
1992	22130	5380	566	1697	7300	520	871	38775	11067
1993	23803	5504	578	1735	9029	645	1075	42687	12182
1994	24876	5631	591	1776	10830	773	1289	46096	13154
1995	25769	5758	605	1815	12713	907	1512	49421	14104
1996	26661	5892	619	1857	13350	954	1589	51266	14631
1997	27531	6028	633	1900	13654	976	1627	52704	15041
1998	28448	6166	647	1944	13970	999	1663	54198	15468
1999	29410	6308	665	1989	14292	1022	1701	55753	15912
2000	30400	6454	679	2036	14620	1045	1740	57350	16368
2001	31434	6603	695	2081	14956	1068	1780	59004	16839
2002	32443	6753	710	2130	15299	1093	1823	60645	17307
2003	33500	6909	727	2179	15653	1119	1864	62355	17795
2004	34559	7067	743	2228	16011	1144	1907	64073	18286
2005	35616	7230	760	2280	16381	1170	1949	65811	18782
2006	36720	7396	778	2333	16755	1198	1994	67610	19295
2007	37896	7567	796	2386	17144	1225	2040	69497	19833
2008	39047	7740	812	2442	17530	1253	2087	71375	20370
2009	40293	7919	833	2497	17941	1280	2135	73384	20937
2010	41467	8100	850	2553	18353	1310	2185	75297	21489
2011	42760	8286	870	2614	18775	1341	2235	77367	22080
2012	44053	8478	890	2673	19208	1372	2287	79480	22678
2013	45345	8673	912	2735	19647	1408	2338	81586	23278
2014	46708	8872	933	2798	20101	1435	2393	83761	23904
2015	48071	9076	954	2862	20562	1469	2448	85977	24536

STUDY:ISLKIDED; CALC:CENTRAL; TBL:C1A; CASES: GHILL GLN GRIV OXH RSL STP WAS

TABLE 2-8 - CASE 1

ISLAND LAKE AREA ENERGY FORECAST 1980/81 TO 2015/16
GARDENHILL ,2.35 PCT POP. GROWTH, 6.85 TO 5.43 PRS PER HOUSE
CENTRAL SYSTEM SUPPLY
TABLE 2
BASE YEAR 1980

YEAR	ESTIMATED POPUL'N	REQ'D HOUSES	OLD HOUSES	MWH CONSUMP'N OLD HOUSES	NEW HOUSES	MWH CONSUMP'N NEW HOUSES	MWH TOTAL HOUSE CONSUMP'N	MWH ESTIMATED COMMER'L CONSUMP'N	MWH ESTIMATED COMMER'L HEATING	MWH TOTAL COMMER'L + HOUSES	ESTIMATED NO. OF ST LIGHTS	MWH ESTIMATED ST LIGHT CONSUMP'N
1980	1740	254	254	1266	0	0	1266	1614	0	2880	105	77
1981	1718	265	254	1382	11	60	1442	1668	0	3110	128	93
1982	1749	260	254	1494	6	35	1529	1598	0	3117	137	101
1983	1790	258	254	1320	4	21	1341	1625	0	2966	122	90
1984	1832	271	254	1320	17	88	1408	1662	0	3070	128	94
1985	1875	284	254	1320	30	156	1476	1700	0	3176	134	98
1986	1919	298	254	1320	44	229	1549	1740	0	3289	141	104
1987	1964	313	254	1320	59	307	1627	1780	0	3407	148	109
1988	2011	328	258	1876	70	1645	3521	1820	440	5781	155	114
1989	2058	344	258	2064	86	2021	4085	1862	899	6846	162	119
1990	2106	361	258	2270	103	2421	4691	1905	1380	7976	170	125
1991	2156	397	258	2611	139	3267	5878	1949	2407	10982	192	141
1992	2206	406	258	3003	148	3478	6481	1994	2955	11881	196	144
1993	2258	416	258	3153	158	3713	6866	2040	3487	12715	201	148
1994	2311	426	258	3153	168	3948	7101	2087	3527	12715	206	151
1995	2366	436	258	3153	178	4183	7336	2135	4124	13595	211	155
1996	2421	446	258	3153	188	4418	7571	2184	4219	13974	215	158
1997	2478	456	258	3153	198	4653	7806	2234	4318	14356	220	162
1998	2536	467	258	3153	209	4912	8065	2285	4415	14765	226	166
1999	2596	478	258	3153	220	5170	8323	2338	4517	15178	231	170
2000	2657	489	258	3153	231	5429	8582	2392	4620	15594	236	173
2001	2719	501	258	3153	243	5711	8864	2447	4727	16038	242	178
2002	2783	513	258	3153	255	5993	9146	2503	4835	16484	248	182
2003	2849	525	258	3153	267	6275	9428	2560	4947	16935	253	185
2004	2916	537	258	3153	279	6557	9710	2619	5060	17393	260	191
2005	2984	550	258	3153	292	6862	10015	2680	5177	17872	265	195
2006	3054	562	258	3153	304	7144	10297	2741	5296	18334	272	200
2007	3126	576	258	3153	318	7473	10626	2804	5418	18848	278	204
2008	3199	589	258	3153	331	7779	10932	2869	5542	19343	285	209
2009	3275	603	258	3153	345	8108	11261	2935	5670	19866	291	214
2010	3352	617	258	3153	359	8437	11590	3002	5800	20392	298	219
2011	3430	632	258	3153	374	8789	11942	3071	5933	20946	305	224
2012	3511	647	258	3153	389	9142	12295	3142	6070	21507	312	229
2013	3593	662	258	3153	404	9494	12647	3214	6210	22071	320	235
2014	3678	677	258	3153	419	9847	13000	3288	6352	22640	327	240
2015	3764	693	258	3153	435	10223	13376	3364	6498	23238		

STUDY:ISLKIDED; CALC:CENTRAL; TBL:C1; CASES: GHILL

ISLAND LAKE AREA ENERGY FORECAST 1980/81 TO 2015/16
GARDENHILL ,2.35 PCT POP. GROWTH, 6.85 TO 5.43 PRS PER HOUSE
CENTRAL SYSTEM SUPPLY
TABLE 2A
BASE YEAR 1980

YEAR	MWH TOTAL HOUSE CONSUMP'N	FED LIGHTING LOAD MWH	PROV LIGHTING LOAD MWH	OTHER LIGHTING LOAD MWH	FED HEATING LOAD MWH	PROV HEATING LOAD MWH	OTHER HEATING LOAD MWH	MWH TOTAL C + H + S CONSUMP'N	PEAK DEMAND KW
1980	1266	1136	119	358	0	0	0	2957	675
1981	1442	1174	123	370	0	0	0	3203	731
1982	1529	1118	118	353	0	0	0	3218	735
1983	1341	1144	120	361	0	0	0	3056	698
1984	1408	1170	123	369	0	0	0	3164	722
1985	1476	1197	126	377	0	0	0	3274	747
1986	1549	1225	129	388	0	0	0	3393	775
1987	1627	1253	132	395	0	0	0	3516	803
1988	3521	1282	135	404	386	26	44	5895	1662
1989	4085	1311	138	413	756	54	90	6965	1968
1990	4691	1341	141	423	1159	83	138	8101	2312
1991	5878	1372	144	433	1581	113	186	9847	2810
1992	6481	1404	148	443	2022	144	241	11023	3146
1993	6866	1436	151	453	2483	177	296	12005	3426
1994	7101	1469	154	463	2963	212	353	12863	3671
1995	7336	1503	158	474	3464	247	412	13746	3923
1996	7571	1537	162	485	3544	253	422	14129	4032
1997	7806	1573	165	496	3625	259	432	14514	4142
1998	8065	1609	169	507	3709	265	441	14927	4260
1999	8323	1646	173	519	3794	271	452	15344	4379
2000	8582	1684	177	531	3881	277	462	15764	4499
2001	8864	1722	181	543	3970	284	473	16211	4626
2002	9146	1762	185	556	4062	290	484	16682	4755
2003	9428	1803	189	568	4155	297	495	17117	4885
2004	9710	1844	194	581	4251	304	506	17575	5016
2005	10015	1886	198	595	4348	311	518	18063	5155
2006	10297	1930	203	609	4448	318	530	18529	5288
2007	10626	1974	208	623	4551	325	542	19048	5436
2008	10932	2020	212	637	4655	333	554	19547	5578
2009	11261	2066	217	652	4763	340	567	20075	5729
2010	11590	2114	222	666	4872	348	580	20608	5881
2011	11942	2162	227	682	4984	356	593	21165	6040
2012	12295	2212	233	698	5099	364	607	21731	6202
2013	12647	2263	238	714	5216	373	621	22300	6364
2014	13000	2315	243	730	5336	381	635	22875	6528
2015	13376	2368	249	747	5459	390	650	23478	6700

STUDY:ISLKIDED; CALC:CENTRAL; TBL:C1A; CASES: GHILL

TABLE 2-8(a) - CASE 1

ISLAND LAKE AREA ENERGY FORECAST 1980/81 TO 2015/16
GODS LAKE NARROWS ,2.35 PCT POP. GROWTH,6.986 TO 5.43 PRS PER HOUS
CENTRAL SYSTEM SUPPLY
TABLE 2
BASE YEAR 1980

YEAR	ESTIMATED POPUL'N	REQ'D HOUSES	OLD HOUSES	MWH CONSUMP'N OLD HOUSES	NEW HOUSES	MWH CONSUMP'N NEW HOUSES	MWH TOTAL HOUSE CONSUMP'N	MWH ESTIMATED COMMER'L CONSUMP'N	MWH ESTIMATED COMMER'L HEATING	MWH TOTAL COMMER'L + HOUSES	ESTIMATED NO. OF ST LIGHTS	MWH ESTIMATED ST LIGHT CONSUMP'N
1980	992	142	142	777	0	0	777	1168	0	1945	27	20
1981	1015	150	142	721	8	41	762	1252	0	2014	28	21
1982	1025	153	142	686	11	53	739	1154	0	1893	34	25
1983	1050	160	142	675	18	86	761	1181	0	1942	32	24
1984	1074	166	142	675	24	114	789	1208	0	1997	33	24
1985	1100	173	142	675	31	147	822	1236	0	2058	35	26
1986	1125	180	142	675	38	181	856	1264	0	2120	36	26
1987	1152	188	142	675	46	219	894	1293	0	2187	38	28
1988	1179	196	160	1064	36	846	1910	1323	293	3526	39	29
1989	1207	204	160	1171	44	1034	2205	1354	600	4159	41	30
1990	1235	213	160	1288	53	1246	2534	1385	921	4840	43	32
1991	1264	223	160	1481	73	1716	3197	1416	1258	5869	47	35
1992	1294	238	160	1703	78	1833	3536	1449	1606	6591	48	35
1993	1324	244	160	1788	84	1974	3762	1482	1971	7215	49	36
1994	1355	250	160	1788	90	2115	3903	1516	2353	7772	50	37
1995	1387	255	160	1788	95	2233	4021	1551	2751	8323	51	37
1996	1420	262	160	1788	102	2397	4185	1587	2814	8586	52	38
1997	1453	268	160	1788	108	2538	4326	1624	2879	8829	54	40
1998	1487	274	160	1788	114	2679	4467	1661	2945	9073	55	40
1999	1522	280	160	1788	120	2820	4608	1699	3013	9320	56	41
2000	1558	287	160	1788	127	2985	4773	1738	3082	9593	57	42
2001	1594	294	160	1788	134	3149	4937	1778	3153	9868	59	43
2002	1632	301	160	1788	141	3314	5102	1819	3226	10147	60	44
2003	1670	308	160	1788	148	3478	5266	1861	3300	10427	62	46
2004	1709	315	160	1788	155	3643	5431	1904	3376	10711	63	46
2005	1750	322	160	1788	162	3807	5595	1947	3453	10995	64	47
2006	1791	330	160	1788	170	3995	5783	1992	3533	11308	66	49
2007	1833	338	160	1788	178	4183	5971	2038	3614	11623	68	50
2008	1876	345	160	1788	185	4348	6136	2085	3697	11918	69	51
2009	1920	354	160	1788	194	4559	6347	2133	3782	12262	71	52
2010	1965	362	160	1788	202	4747	6535	2182	3869	12586	72	53
2011	2011	370	160	1788	210	4935	6723	2232	3958	12913	74	54
2012	2059	379	160	1788	219	5147	6935	2283	4049	13267	76	56
2013	2107	388	160	1788	228	5358	7146	2336	4142	13624	78	57
2014	2158	397	160	1788	237	5570	7358	2390	4237	13985	79	58
2015	2207	406	160	1788	246	5781	7569	2445	4335	14349	81	60

STUDY:ISLKIDED; CALC:CENTRAL; TBL:C1; CASES: GLN

ISLAND LAKE AREA ENERGY FORECAST 1980/81 TO 2015/16
GODS LAKE NARROWS ,2.35 PCT POP. GROWTH,6.986 TO 5.43 PRS PER HOUS
CENTRAL SYSTEM SUPPLY
TABLE 2A
BASE YEAR 1980

YEAR	MWH TOTAL HOUSE CONSUMP'N	FED LIGHTING LOAD MWH	PROV LIGHTING LOAD MWH	OTHER LIGHTING LOAD MWH	FED HEATING LOAD MWH	PROV HEATING LOAD MWH	OTHER HEATING LOAD MWH	MWH TOTAL C + H + S CONSUMP'N	PEAK DEMAND KW
1980	777	822	86	259	0	0	0	1965	449
1981	762	881	93	278	0	0	0	2035	465
1982	739	813	85	256	0	0	0	1918	438
1983	761	831	87	262	0	0	0	1566	449
1984	789	850	89	268	0	0	0	2021	461
1985	822	870	91	274	0	0	0	2084	476
1986	856	890	94	281	0	0	0	2146	490
1987	894	911	96	287	0	0	0	2215	506
1988	1910	931	98	294	248	18	29	3555	1015
1989	2205	953	100	300	504	36	60	4189	1195
1990	2534	975	102	307	773	55	92	4872	1390
1991	3197	997	105	314	1055	75	126	5304	1685
1992	3536	1020	107	322	1349	96	161	6528	1691
1993	3762	1044	110	329	1656	118	197	7251	2056
1994	3903	1068	112	337	1976	141	235	7809	2225
1995	4021	1092	115	344	2311	165	275	8360	2386
1998	4185	1117	117	352	2364	169	281	8624	2461
1997	4326	1143	120	360	2418	173	286	8869	2531
1998	4467	1169	123	369	2474	177	295	9113	2601
1999	4608	1196	126	377	2531	181	301	9361	2672
2000	4773	1224	129	386	2589	185	308	9635	2750
2001	4937	1252	132	395	2649	189	315	9911	2828
2002	5102	1281	135	404	2709	194	323	10191	2908
2003	5266	1310	138	413	2772	198	330	10473	2989
2004	5431	1340	141	423	2835	203	338	10757	3070
2005	5595	1371	144	432	2901	207	345	11042	3151
2006	5783	1403	147	442	2967	212	353	11357	3241
2007	5971	1435	151	452	3036	217	361	11673	3331
2008	6138	1468	154	463	3106	222	370	11989	3416
2009	6347	1502	158	474	3177	227	378	12314	3514
2010	6535	1536	161	484	3250	232	387	12639	3607
2011	6723	1571	165	496	3325	237	396	12967	3701
2012	6935	1608	169	507	3401	243	405	13323	3802
2013	7146	1645	173	519	3479	249	414	13681	3904
2014	7358	1682	177	531	3559	254	424	14043	4008
2015	7569	1721	181	543	3641	260	433	14409	4112

STUDY:ISLKIDED; CALC:CENTRAL; TBL:C1A; CASES: GLN

TABLE 2-8(b) - CASE 1

ISLAND LAKE AREA ENERGY FORECAST 1980/81 TO 2015/16
GODS RIVER ,2.35 PCT POP. GROUTH,6.44 TO 5.43 PRS PER HOUSE
CENTRAL SYSTEM SUPPLY
TABLE 2
BASE YEAR 1980

YEAR	ESTIMATED POPUL'N	REQ'D HOUSES	OLD HOUSES	FLW CONSUMP'N OLD HOUSES	NEW HOUSES	FLW CONSUMP'N NEW HOUSES	FLW TOTAL HOUSE CONSUMP'N	FLW ESTIMATED COMMER'L CONSUMP'N	FLW ESTIMATED COMMER'L HEATING	FLW TOTAL COMMER'L + HOUSES	ESTIMATED NO. OF ST LIGHTS	FLW ESTIMATED ST LIGHT CONSUMP'N
1980	243	38	38	195	0	0	195	176	0	371	14	10
1981	251	39	38	206	1	5	211	181	0	392	15	11
1982	247	42	38	217	4	23	240	181	0	421	16	12
1983	253	42	38	193	4	20	213	185	0	398	16	12
1984	259	43	38	193	5	25	218	189	0	407	16	12
1985	265	44	38	193	6	30	223	194	0	417	17	12
1986	271	46	38	193	8	41	234	198	0	432	17	12
1987	277	47	38	193	9	46	239	203	0	442	18	13
1988	284	49	38	193	11	56	249	207	0	456	19	14
1989	291	50	42	298	8	188	486	212	48	746	19	14
1990	297	52	42	328	10	235	563	217	98	878	20	15
1991	304	56	42	361	14	329	690	222	151	1063	21	15
1992	312	57	42	415	15	353	768	227	205	1200	22	16
1993	319	59	42	477	17	400	877	232	263	1372	22	16
1994	326	60	42	501	18	423	924	238	322	1484	23	17
1995	334	62	42	501	20	470	971	243	385	1599	23	17
1996	342	63	42	501	21	494	995	249	450	1694	24	18
1997	350	64	42	501	22	517	1018	255	460	1733	24	18
1998	358	66	42	501	24	564	1065	280	471	1796	25	18
1999	367	68	42	501	26	611	1112	266	481	1859	26	19
2000	375	69	42	501	27	635	1136	273	493	1902	26	19
2001	384	71	42	501	29	682	1183	279	504	1966	27	20
2002	393	72	42	501	30	705	1206	285	515	2006	27	20
2003	402	74	42	501	32	752	1253	292	527	2072	28	21
2004	412	76	42	501	34	799	1300	298	539	2137	29	21
2005	421	78	42	501	36	846	1347	305	552	2204	29	21
2006	431	79	42	501	37	870	1371	312	565	2248	30	22
2007	441	81	42	501	39	917	1418	320	577	2315	31	23
2008	452	83	42	501	41	964	1465	327	591	2383	31	23
2009	462	85	42	501	43	1011	1512	334	604	2450	32	24
2010	473	87	42	501	45	1058	1559	342	618	2519	33	24
2011	484	89	42	501	47	1105	1606	350	632	2588	34	25
2012	496	91	42	501	49	1152	1653	358	647	2658	34	25
2013	507	93	42	501	51	1199	1700	366	662	2728	35	26
2014	519	96	42	501	54	1269	1770	375	677	2822	36	26
2015	532	98	42	501	56	1316	1817	383	693	2893	37	27

STUDY:ISLKIDED; CALC:CENTRAL; TBL:C1; CASES: GRIV

ISLAND LAKE AREA ENERGY FORECAST 1980/81 TO 2015/16
GODS RIVER ,2.35 PCT POP. GROUTH,6.44 TO 5.43 PRS PER HOUSE
CENTRAL SYSTEM SUPPLY
TABLE 2A
BASE YEAR 1980

YEAR	FLW TOTAL HOUSE CONSUMP'N	FED LIGHTING LOAD FLW	PROV LIGHTING LOAD FLW	OTHER LIGHTING LOAD FLW	FED HEATING LOAD FLW	PROV HEATING LOAD FLW	OTHER HEATING LOAD FLW	FLW TOTAL C + H + S CONSUMP'N	PEAK DEMAND KW
1980	195	124	13	39	0	0	0	381	87
1981	211	128	13	40	0	0	0	403	92
1982	240	127	13	40	0	0	0	433	99
1983	213	130	14	41	0	0	0	410	94
1984	218	133	14	42	0	0	0	419	96
1985	223	136	14	43	0	0	0	429	98
1986	234	140	15	44	0	0	0	444	101
1987	239	143	15	45	0	0	0	455	104
1988	249	146	15	45	0	0	0	470	107
1989	486	149	16	47	40	3	5	760	217
1990	563	153	16	48	82	6	10	893	255
1991	690	156	16	49	126	9	15	1078	309
1992	768	160	17	50	172	12	21	1216	347
1993	877	164	17	52	221	16	26	1388	398
1994	924	167	18	53	271	19	32	1501	428
1995	971	171	18	54	323	23	38	1616	461
1996	995	175	18	55	378	27	45	1712	489
1997	1018	179	19	57	386	28	46	1751	500
1998	1065	183	19	58	395	28	47	1814	518
1999	1112	188	20	59	404	29	48	1878	536
2000	1136	192	20	61	414	30	49	1921	548
2001	1183	196	21	62	423	30	50	1986	567
2002	1206	201	21	63	433	31	52	2026	578
2003	1253	205	22	65	443	32	53	2093	597
2004	1300	210	22	66	453	32	54	2158	616
2005	1347	215	23	68	464	33	55	2225	635
2006	1371	220	23	69	474	34	56	2270	648
2007	1418	225	24	71	485	35	58	2338	667
2008	1465	230	24	73	496	35	59	2406	687
2009	1512	235	25	74	508	36	60	2474	706
2010	1559	241	25	76	519	37	62	2543	726
2011	1606	246	26	78	531	38	63	2613	746
2012	1653	252	26	79	544	39	65	2683	766
2013	1700	258	27	81	556	40	66	2754	786
2014	1770	264	28	83	569	41	68	2848	813
2015	1817	270	28	85	582	42	69	2920	833

STUDY:ISLKIDED; CALC:CENTRAL; TBL:C1A; CASES: GRIV

TABLE 2-8(c) - CASE 1

ISLAND LAKE AREA ENERGY FORECAST 1980/81 TO 2015/16
OXFORD HOUSE ,2.35 PCT POP. GROWTH,5.856 TO 5.43 PRS PER HOUSE
CENTRAL SYSTEM SUPPLY
TABLE 2
BASE YEAR 1980

YEAR	ESTIMATED POPUL'N	REQ'D HOUSES	OLD HOUSES	MWH CONSUMP'N OLD HOUSES	NEW HOUSES	MWH CONSUMP'N NEW HOUSES	MWH TOTAL HOUSE CONSUMP'N	MWH ESTIMATED COMMER'L CONSUMP'N	MWH ESTIMATED COMMER'L HEATING	MWH TOTAL COMMER'L + HOUSES	ESTIMATED NO. OF ST LIGHTS	MWH ESTIMATED ST LIGHT CONSUMP'N
1980	999	173	173	868	0	0	868	954	0	1822	22	16
1981	1025	177	173	747	4	17	764	904	0	1668	23	17
1982	1095	187	173	903	14	73	976	980	0	1956	25	18
1983	1121	199	173	820	26	123	943	1003	0	1946	26	19
1984	1147	204	173	820	31	147	967	1026	0	1993	27	20
1985	1174	208	173	820	35	166	986	1049	0	2035	27	20
1986	1202	213	173	820	40	190	1010	1074	0	2084	28	21
1987	1230	217	199	1321	18	423	1744	1098	283	3125	28	21
1988	1259	222	199	1453	23	541	1994	1123	580	3697	29	21
1989	1288	227	199	1598	28	658	2256	1149	890	4295	30	22
1990	1319	232	199	1838	33	776	2614	1178	1214	5004	30	22
1991	1350	249	199	2113	50	1175	3288	1208	1577	6073	32	24
1992	1381	254	199	2219	55	1293	3512	1238	1905	6647	33	24
1993	1414	260	199	2219	61	1434	3653	1259	2274	7186	34	25
1994	1447	266	199	2219	67	1575	3794	1288	2658	7740	35	26
1995	1481	273	199	2219	74	1739	3958	1317	2719	7994	36	26
1996	1516	279	199	2219	80	1880	4099	1348	2782	8229	36	26
1997	1552	286	199	2219	87	2045	4264	1379	2846	8489	37	27
1998	1588	292	199	2219	93	2186	4405	1410	2911	8726	38	28
1999	1625	299	199	2219	100	2350	4569	1443	2978	8990	39	29
2000	1664	306	199	2219	107	2515	4734	1476	3047	9257	40	29
2001	1703	314	199	2219	115	2703	4922	1510	3117	9549	41	30
2002	1743	321	199	2219	122	2867	5086	1545	3188	9819	42	31
2003	1784	329	199	2219	130	3055	5274	1580	3262	10116	43	32
2004	1826	336	199	2219	137	3220	5439	1616	3337	10392	44	32
2005	1869	344	199	2219	145	3408	5627	1654	3414	10695	45	33
2006	1912	352	199	2219	153	3596	5815	1692	3492	10999	46	34
2007	1957	360	199	2219	161	3784	6003	1731	3572	11306	47	35
2008	2003	369	199	2219	170	3995	6214	1770	3655	11639	48	35
2009	2050	378	199	2219	179	4207	6426	1811	3739	11976	49	36
2010	2099	387	199	2219	188	4418	6637	1853	3825	12315	50	37
2011	2148	396	199	2219	197	4630	6849	1895	3913	12657	52	38
2012	2198	405	199	2219	206	4841	7060	1939	4003	13002	53	39
2013	2250	414	199	2219	215	5053	7272	1984	4095	13351	54	40
2014	2303	424	199	2219	225	5288	7507	2029	4189	13725	55	40
2015	2357	434	199	2219	235	5523	7742	2076	4285	14103	57	42

STUDY:ISLKIDED; CALC:CENTRAL; TBL:C1; CASES: OXH

ISLAND LAKE AREA ENERGY FORECAST 1980/81 TO 2015/16
OXFORD HOUSE ,2.35 PCT POP. GROWTH,5.856 TO 5.43 PRS PER HOUSE
CENTRAL SYSTEM SUPPLY
TABLE 2A
BASE YEAR 1980

YEAR	MWH TOTAL HOUSE CONSUMP'N	FED LIGHTING LOAD MWH	PROV LIGHTING LOAD MWH	OTHER LIGHTING LOAD MWH	FED HEATING LOAD MWH	PROV HEATING LOAD MWH	OTHER HEATING LOAD MWH	MWH TOTAL C + H + S CONSUMP'N	PEAK DEMAND KW
1980	868	672	71	212	0	0	0	1938	420
1981	764	637	67	201	0	0	0	1685	385
1982	976	690	73	218	0	0	0	1974	451
1983	943	706	74	223	0	0	0	1965	449
1984	967	722	76	228	0	0	0	2013	460
1985	986	739	78	233	0	0	0	2055	469
1986	1010	756	79	238	0	0	0	2105	481
1987	1744	773	81	244	238	17	28	3146	859
1988	1994	791	83	249	487	35	56	3718	1065
1989	2256	809	85	255	747	53	89	4317	1232
1990	2614	828	87	261	1019	72	121	5028	1434
1991	3288	847	89	267	1304	93	155	6087	1731
1992	3512	868	91	273	1600	114	190	6671	1904
1993	3653	886	93	279	1910	136	227	7211	2058
1994	3794	907	95	285	2233	159	266	7786	2216
1995	3958	927	97	292	2284	163	272	8020	2285
1996	4099	949	100	299	2337	167	278	8255	2356
1997	4264	971	102	306	2390	171	285	8518	2430
1998	4405	993	104	313	2445	175	291	8754	2498
1999	4569	1016	107	320	2502	179	298	9019	2574
2000	4734	1039	109	328	2559	183	305	9266	2650
2001	4922	1063	112	335	2618	187	312	9579	2734
2002	5086	1087	114	343	2678	191	319	9850	2811
2003	5274	1112	117	351	2740	196	328	10148	2898
2004	5439	1138	120	359	2803	200	334	10424	2975
2005	5627	1164	122	367	2867	205	341	10728	3062
2006	5815	1191	125	376	2933	210	349	11033	3149
2007	6003	1218	128	384	3001	214	357	11341	3237
2008	6214	1246	131	393	3070	219	365	11674	3332
2009	6426	1275	134	402	3140	224	374	12012	3428
2010	6637	1304	137	411	3213	229	382	12352	3525
2011	6849	1334	140	421	3287	235	391	12695	3623
2012	7060	1365	143	430	3362	240	400	13041	3722
2013	7272	1396	147	440	3440	246	409	13391	3822
2014	7507	1429	150	450	3519	251	419	13765	3928
2015	7742	1461	154	461	3600	257	429	14145	4037

STUDY:ISLKIDED; CALC:CENTRAL; TBL:C1A; CASES: OXH

TABLE 2-8(d) - CASE 1

ISLAND LAKE AREA ENERGY FORECAST 1980/81 TO 2015/16
RED SUCKER LAKE ,2.35 PCT POP. GROWTH,7.32 TO 5.43 PRS PER HOUSE
CENTRAL SYSTEM SUPPLY
TABLE 2
BASE YEAR 1980

YEAR	ESTIMATED POPUL'N	REQ'D HOUSES	OLD HOUSES	MWH CONSUMP'N OLD HOUSES	NEW HOUSES	MWH CONSUMP'N NEW HOUSES	MWH TOTAL HOUSE CONSUMP'N	MWH ESTIMATED COMMER'L CONSUMP'N	MWH ESTIMATED COMMER'L HEATING	MWH TOTAL COMMER'L + HOUSES	ESTIMATED NO. OF ST LIGHTS	MWH ESTIMATED ST LIGHT CONSUMP'N
1980	366	50	50	292	0	0	292	331	0	623	12	9
1981	386	52	50	257	2	10	267	317	0	584	12	9
1982	387	54	50	313	4	25	338	437	0	775	15	11
1983	378	54	50	250	4	20	270	447	0	717	13	10
1984	384	56	50	250	6	30	280	457	0	737	14	10
1985	393	59	50	250	9	45	295	467	0	762	15	11
1986	403	62	50	250	12	60	310	478	0	788	15	11
1987	412	65	50	250	15	75	325	489	0	814	16	12
1988	422	69	50	250	19	95	345	500	0	845	17	12
1989	432	72	54	378	18	423	801	512	100	1413	18	13
1990	442	78	54	416	22	517	933	524	204	1661	19	14
1991	452	83	54	458	29	682	1140	538	313	1989	21	15
1992	463	85	54	526	31	729	1255	548	427	2230	21	15
1993	474	87	54	805	33	776	1381	561	546	2488	22	16
1994	485	89	54	836	35	823	1459	574	671	2704	22	16
1995	496	91	54	638	37	870	1508	587	915	3008	23	17
1996	508	94	54	636	40	940	1576	600	936	3112	23	17
1997	520	98	54	636	42	987	1623	614	958	3195	24	18
1998	532	98	54	636	44	1034	1670	628	980	3278	24	18
1999	545	100	54	636	46	1081	1717	643	1002	3362	25	18
2000	558	103	54	636	49	1152	1788	657	1025	3470	26	19
2001	571	105	54	636	51	1199	1835	673	1049	3557	26	19
2002	584	108	54	636	54	1269	1905	688	1073	3666	27	20
2003	598	110	54	636	56	1316	1952	704	1098	3754	27	20
2004	612	113	54	636	59	1367	2023	720	1123	3866	28	21
2005	626	115	54	636	61	1434	2070	737	1149	3956	29	21
2006	641	118	54	636	64	1504	2140	754	1175	4069	29	21
2007	656	121	54	636	67	1575	2211	771	1202	4184	30	22
2008	671	124	54	636	70	1645	2281	789	1230	4300	31	23
2009	687	127	54	636	73	1716	2352	807	1258	4417	32	24
2010	703	129	54	636	75	1763	2399	825	1287	4511	32	24
2011	720	133	54	636	78	1857	2493	844	1317	4654	33	24
2012	737	136	54	636	82	1927	2563	864	1347	4774	34	25
2013	754	139	54	636	85	1998	2634	884	1378	4896	35	26
2014	772	142	54	636	88	2068	2704	904	1409	5017	35	26
2015	790	145	54	636	91	2139	2775	925	1442	5142	36	26

STUDY:ISLKIDED; CALC:CENTRAL; TBL:C1; CASES: RSL

ISLAND LAKE AREA ENERGY FORECAST 1980/81 TO 2015/16
RED SUCKER LAKE ,2.35 PCT POP. GROWTH,7.32 TO 5.43 PRS PER HOUSE
CENTRAL SYSTEM SUPPLY
TABLE 2A
BASE YEAR 1980

YEAR	MWH TOTAL HOUSE CONSUMP'N	FED LIGHTING LOAD MWH	PROV LIGHTING LOAD MWH	OTHER LIGHTING LOAD MWH	FED HEATING LOAD MWH	PROV HEATING LOAD MWH	OTHER HEATING LOAD MWH	MWH TOTAL C + H + S CONSUMP'N	PEAK DEMAND KW
1980	292	233	25	74	0	0	0	632	144
1981	267	223	23	70	0	0	0	583	135
1982	338	307	32	97	0	0	0	727	166
1983	270	314	33	99	0	0	0	717	171
1984	280	322	34	101	0	0	0	773	176
1985	295	329	35	104	0	0	0	788	182
1986	310	337	35	106	0	0	0	826	189
1987	325	344	36	109	0	0	0	857	196
1988	345	352	37	111	0	0	0	1436	427
1989	801	360	38	114	84	6	10	1675	476
1990	933	369	39	116	171	12	20	2004	572
1991	1140	377	40	119	263	19	31	2245	641
1992	1255	386	41	122	359	28	43	2504	715
1993	1381	395	41	124	459	33	55	2720	776
1994	1459	404	42	127	563	40	67	3025	863
1995	1508	413	43	130	769	55	91	3129	893
1998	1576	423	44	133	786	56	94	3213	917
1997	1623	432	45	136	804	57	98	3298	941
1998	1670	442	46	139	823	59	98	3380	965
1999	1717	452	48	143	842	60	100	3488	996
2000	1788	463	49	146	861	62	103	3576	1021
2001	1835	473	50	148	881	63	105	3686	1052
2002	1905	484	51	153	901	64	107	3774	1077
2003	1952	498	52	156	922	66	110	3887	1109
2004	2023	507	53	160	943	67	112	3977	1135
2005	2070	519	55	164	965	69	115	4090	1167
2006	2140	530	56	167	987	71	118	4206	1200
2007	2211	543	57	171	1010	72	120	4323	1234
2008	2281	555	58	175	1033	74	123	4441	1267
2009	2352	568	60	179	1057	75	126	4535	1294
2010	2399	581	61	183	1081	77	129	4678	1335
2011	2493	594	62	187	1106	79	132	4798	1370
2012	2563	609	64	192	1131	81	135	4922	1405
2013	2634	622	65	196	1157	83	138	5043	1439
2014	2704	636	67	201	1184	85	141	5168	1475
2015	2775	651	68	205	1211	87	144	5168	1475

STUDY:ISLKIDED; CALC:CENTRAL; TBL:C1A; CASES: RSL

TABLE 2-8(e) - CASE 1

ISLAND LAKE AREA ENERGY FORECAST 1980/81 TO 2015/16
STE THERESA POINT,2.35 PCT POP. GROWTH,0.391 TO 5.43 PRS PER HOUSE
CENTRAL SYSTEM SUPPLY
TABLE 2
BASE YEAR 1980

YEAR	ESTIMATED POPUL'N	REQ'D HOUSES	OLD HOUSES	MLN CONSUMP'N OLD HOUSES	NEW HOUSES	MLN CONSUMP'N NEW HOUSES	MLN TOTAL HOUSE CONSUMP'N	MLN ESTIMATED COMMER'L CONSUMP'N	MLN ESTIMATED COMMER'L HEATING	MLN TOTAL COMMER'L + HOUSES	ESTIMATED NO. OF ST LIGHTS	MLN ESTIMATED ST LIGHT CONSUMP'N
1980	1267	151	151	847	0	0	847	761	0	1608	28	21
1981	1298	191	151	711	40	188	899	850	0	1749	38	28
1982	1318	211	151	772	60	307	1079	952	0	2031	49	36
1983	1347	214	151	747	63	312	1059	974	0	2033	44	32
1984	1379	222	151	747	71	351	1098	996	0	2094	46	34
1985	1411	230	151	747	79	391	1138	1019	0	2157	47	35
1986	1444	238	151	747	87	431	1178	1042	0	2220	49	36
1987	1478	247	151	747	96	475	1222	1066	0	2288	51	37
1988	1513	256	151	747	105	520	1267	1091	0	2358	53	39
1989	1548	265	214	1483	51	1139	2682	1116	300	4098	54	40
1990	1585	275	214	1631	61	1434	3065	1142	614	4821	56	41
1991	1622	289	214	1794	85	1998	3792	1168	942	5902	61	45
1992	1660	308	214	2084	92	2162	4226	1195	1285	6706	63	46
1993	1699	313	214	2373	99	2327	4700	1222	1643	7585	64	47
1994	1739	320	214	2492	108	2491	4983	1250	2017	8250	66	49
1995	1780	328	214	2492	114	2679	5171	1279	2408	8858	67	49
1996	1822	338	214	2492	122	2867	5359	1308	2815	9482	69	51
1997	1865	343	214	2492	129	3032	5524	1338	2880	9742	70	51
1998	1908	351	214	2492	137	3220	5712	1369	2946	10027	72	53
1999	1953	360	214	2492	146	3431	5923	1401	3014	10338	74	54
2000	1999	368	214	2492	154	3619	6111	1433	3083	10627	76	56
2001	2046	377	214	2492	163	3831	6323	1466	3154	10943	77	57
2002	2094	388	214	2492	172	4042	6534	1500	3226	11260	79	58
2003	2143	395	214	2492	181	4254	6746	1534	3301	11581	81	60
2004	2194	404	214	2492	190	4465	6957	1569	3377	11903	83	61
2005	2245	413	214	2492	198	4677	7169	1606	3454	12229	85	62
2006	2298	423	214	2492	209	4912	7404	1642	3534	12580	87	64
2007	2352	433	214	2492	219	5147	7639	1680	3615	12934	89	65
2008	2407	443	214	2492	229	5382	7874	1719	3698	13291	91	67
2009	2464	454	214	2492	240	5640	8132	1758	3783	13673	93	68
2010	2522	464	214	2492	250	5875	8367	1799	3870	14036	95	70
2011	2581	475	214	2492	261	6134	8626	1840	3959	14425	98	72
2012	2642	487	214	2492	273	6416	8908	1893	4050	14841	100	74
2013	2704	498	214	2492	284	6674	9166	1928	4143	15235	102	75
2014	2767	510	214	2492	296	6956	9448	1970	4239	15657	105	77
2015	2832	522	214	2492	308	7238	9730	2015	4336	16081	107	79

STUDY:ISLKIDED; CALC:CENTRAL; TBL:C1; CASES: STP

ISLAND LAKE AREA ENERGY FORECAST 1980/81 TO 2015/16
STE THERESA POINT,2.35 PCT POP. GROWTH,0.391 TO 5.43 PRS PER HOUSE
CENTRAL SYSTEM SUPPLY
TABLE 2A
BASE YEAR 1980

YEAR	MLN TOTAL HOUSE CONSUMP'N	FED LIGHTING LOAD MLN	PROV LIGHTING LOAD MLN	OTHER LIGHTING LOAD MLN	FED HEATING LOAD MLN	PROV HEATING LOAD MLN	OTHER HEATING LOAD MLN	MLN TOTAL C + H + S CONSUMP'N	PEAK DEMAND KW
1980	847	536	56	189	0	0	0	1629	372
1981	899	599	63	189	0	0	0	1777	406
1982	1079	670	70	211	0	0	0	2057	472
1983	1059	685	72	216	0	0	0	2065	471
1984	1098	701	74	221	0	0	0	2128	486
1985	1138	717	75	226	0	0	0	2192	500
1986	1178	734	77	231	0	0	0	2256	515
1987	1222	751	79	237	0	0	0	2325	531
1988	1267	768	81	242	0	0	0	2397	547
1989	2682	786	83	248	252	18	30	4138	1181
1990	3065	804	84	253	516	37	61	4862	1368
1991	3792	822	86	259	791	57	94	5947	1697
1992	4226	841	88	265	1079	77	129	6752	1927
1993	4700	860	90	271	1380	99	164	7612	2172
1994	4983	880	93	278	1695	121	202	8298	2368
1995	5171	900	95	284	2022	144	241	8907	2542
1996	5359	921	97	290	2365	169	281	9533	2721
1997	5524	942	99	297	2419	173	288	9793	2795
1998	5712	964	101	304	2475	177	295	10080	2877
1999	5923	986	104	311	2532	181	301	10392	2966
2000	6111	1009	106	318	2590	185	308	10683	3049
2001	6323	1032	108	325	2649	189	315	11000	3139
2002	6534	1056	111	333	2710	194	323	11318	3230
2003	6746	1080	114	341	2773	198	330	11641	3322
2004	6957	1105	116	348	2836	203	338	11964	3414
2005	7169	1130	119	356	2902	207	345	12291	3508
2006	7404	1156	122	365	2968	212	353	12644	3608
2007	7639	1183	124	373	3037	217	361	12999	3710
2008	7874	1210	127	382	3106	222	370	13358	3812
2009	8132	1238	130	390	3178	227	378	13741	3922
2010	8367	1266	133	399	3251	232	387	14106	4026
2011	8626	1296	136	409	3326	238	398	14497	4137
2012	8908	1325	139	418	3402	243	405	14915	4257
2013	9166	1356	143	428	3480	249	414	15310	4369
2014	9448	1387	146	437	3561	254	424	15734	4490
2015	9730	1419	149	447	3642	260	434	16160	4612

STUDY:ISLKIDED; CALC:CENTRAL; TBL:C1A; CASES: STP

TABLE 2-8(f) - CASE 1

ISLAND LAKE AREA ENERGY FORECAST 1980/81 TO 2015/16
WASAGOMACH ,2.35 PCT POP GROWTH ,7.593 TO 5.43 PRS PER HOUSE
CENTRAL SYSTEM SUPPLY
TABLE 2
BASE YEAR 1980

YEAR	ESTIMATED POPUL'N	REQ'D HOUSES	OLD HOUSES	MWH CONSUMP'N OLD HOUSES	NEW HOUSES	MWH CONSUMP'N NEW HOUSES	MWH TOTAL HOUSE CONSUMP'N	MWH ESTIMATED COMMER'L CONSUMP'N	MWH ESTIMATED COMMER'L HEATING	MWH TOTAL COMMER'L + HOUSES	ESTIMATED NO. OF ST LIGHTS	MWH ESTIMATED ST LIGHT CONSUMP'N
1980	607	85	85	398	0	0	398	741	0	1139	96	19
1981	655	89	85	433	4	20	453	716	0	1169	27	20
1982	653	86	85	496	1	6	502	795	0	1297	30	22
1983	668	92	85	447	7	37	484	814	0	1298	29	21
1984	684	97	85	447	12	63	510	832	0	1342	31	23
1985	700	102	85	447	17	89	536	851	0	1387	33	24
1986	717	108	85	447	23	121	568	871	0	1439	34	25
1987	733	114	85	447	29	152	599	891	0	1490	36	26
1988	751	120	85	447	35	184	631	912	0	1543	38	28
1989	768	127	92	877	35	823	1500	933	200	2633	41	30
1990	786	134	92	745	42	987	1732	954	409	3095	43	32
1991	805	148	92	819	56	1316	2135	978	628	3739	47	35
1992	824	152	92	942	60	1410	2352	998	856	4208	49	36
1993	843	155	92	1083	63	1481	2564	1021	1095	4680	49	36
1994	863	159	92	1137	67	1575	2712	1045	1344	5101	51	37
1995	883	163	92	1137	71	1669	2806	1069	1834	5709	52	38
1996	904	168	92	1137	74	1739	2876	1093	1876	5845	53	39
1997	925	170	92	1137	78	1833	2970	1119	1919	6008	54	40
1998	947	174	92	1137	82	1927	3064	1144	1963	6171	56	41
1999	969	178	92	1137	86	2021	3158	1171	2008	6337	57	42
2000	992	183	92	1137	91	2139	3276	1198	2055	6529	58	43
2001	1015	187	92	1137	95	2233	3370	1225	2102	6697	60	44
2002	1039	191	92	1137	99	2327	3464	1253	2150	6867	61	45
2003	1064	196	92	1137	104	2444	3581	1282	2200	7063	63	46
2004	1089	201	92	1137	109	2562	3699	1312	2250	7261	64	47
2005	1114	205	92	1137	113	2656	3793	1342	2302	7437	65	48
2006	1140	210	92	1137	118	2773	3910	1373	2355	7638	67	49
2007	1167	215	92	1137	123	2891	4028	1404	2409	7841	69	51
2008	1195	220	92	1137	128	3008	4145	1437	2465	8047	70	51
2009	1223	225	92	1137	133	3126	4263	1470	2521	8254	72	53
2010	1251	230	92	1137	138	3243	4380	1503	2579	8462	73	54
2011	1281	238	92	1137	144	3384	4521	1538	2638	8697	75	55
2012	1311	241	92	1137	149	3502	4639	1573	2699	8911	77	57
2013	1342	247	92	1137	155	3643	4780	1609	2761	9150	79	58
2014	1373	253	92	1137	161	3784	4921	1647	2825	9393	81	60
2015	1405	259	92	1137	167	3925	5062	1684	2890	9636	83	61

STUDY:ISLKIDED; CALC:CENTRAL; TBL:C1; CASES: WAS

ISLAND LAKE AREA ENERGY FORECAST 1980/81 TO 2015/16
WASAGOMACH ,2.35 PCT POP GROWTH ,7.593 TO 5.43 PRS PER HOUSE
CENTRAL SYSTEM SUPPLY
TABLE 2A
BASE YEAR 1980

YEAR	MWH TOTAL HOUSE CONSUMP'N	FED LIGHTING LOAD MWH	PROV LIGHTING LOAD MWH	OTHER LIGHTING LOAD MWH	FED HEATING LOAD MWH	PROV HEATING LOAD MWH	OTHER HEATING LOAD MWH	MWH TOTAL C + H + S CONSUMP'N	PEAK DEMAND KW
1980	398	522	55	185	0	0	0	1158	264
1981	453	504	53	159	0	0	0	1189	271
1982	502	560	59	177	0	0	0	1319	301
1983	484	573	60	181	0	0	0	1319	301
1984	510	586	62	185	0	0	0	1365	312
1985	536	599	63	189	0	0	0	1411	322
1986	568	613	64	193	0	0	0	1464	334
1987	599	627	66	198	0	0	0	1516	346
1988	631	642	67	202	0	0	0	1571	359
1989	1500	657	69	207	168	12	20	2663	760
1990	1732	672	71	212	344	25	41	3127	892
1991	2135	687	72	217	527	38	63	3774	1077
1992	2352	703	74	222	719	51	86	4242	1211
1993	2564	719	76	227	920	66	110	4718	1346
1994	2712	736	77	232	1129	81	134	5138	1466
1995	2806	752	79	237	1340	110	183	5747	1640
1996	2876	770	81	243	1576	113	188	5884	1679
1997	2970	788	83	248	1612	115	192	6048	1726
1998	3064	806	85	254	1649	118	196	6212	1773
1999	3158	824	87	260	1687	121	201	6378	1820
2000	3276	843	89	266	1726	123	205	6572	1876
2001	3370	862	91	272	1766	126	210	6741	1924
2002	3464	882	93	278	1806	129	215	6912	1973
2003	3581	903	95	285	1848	132	220	7109	2029
2004	3699	923	97	291	1890	135	225	7308	2086
2005	3793	945	99	298	1934	138	230	7485	2136
2006	3910	966	102	305	1978	141	235	7687	2194
2007	4028	989	104	312	2024	145	241	7892	2252
2008	4145	1011	106	319	2070	148	246	8098	2311
2009	4263	1035	109	326	2118	151	252	8307	2371
2010	4380	1058	111	334	2167	155	258	8516	2430
2011	4521	1083	114	341	2216	158	264	8752	2498
2012	4639	1108	116	349	2267	162	270	8968	2559
2013	4780	1133	119	357	2319	166	276	9208	2628
2014	4921	1159	122	366	2373	169	282	9453	2698
2015	5062	1186	125	374	2427	173	289	9697	2767

STUDY:ISLKIDED; CALC:CENTRAL; TBL:C1A; CASES: WAS

TABLE 2-8(g) - CASE 1

ISLAND LAKE AREA ENERGY FORECAST 1980/81 TO 2015/16
GARDENHILL ,2.35 PCT POP. GROWTH, 6.85 TO 5.43 PRS PER HOUSE
PLUS:GODS LAKE NARROWS ,2.35 PCT POP. GROWTH,6.986 TO 5.43 PRS PER HOUS
PLUS:GODS RIVER ,2.35 PCT POP. GROWTH,6.44 TO 5.43 PRS PER HOUSE
PLUS:OXFORD HOUSE ,2.35 PCT POP. GROWTH,5.856 TO 5.43 PRS PER HOUSE
PLUS:RED SUCKER LAKE ,2.35 PCT POP. GROWTH,7.32 TO 5.43 PRS PER HOUSE
PLUS:STE THERESA POINT,2.35 PCT POP. GROWTH,8.391 TO 5.43 PRS PER HOUSE
PLUS:WASAGAMACH ,2.35 PCT POP GROWTH ,7.593 TO 5.43 PRS PER HOUSE
CENTRAL SYSTEM SUPPLY - NO RESIDENTIAL ELECTRICHEAT
TABLE 2
BASE YEAR 1980

YEAR	ESTIMATED POPUL'N	PEG'D HOUSES	OLD HOUSES	MWH CONSUMP'N OLD HOUSES	NEW HOUSES	MWH CONSUMP'N NEW HOUSES	MWH TOTAL HOUSE CONSUMP'N	MWH ESTIMATED COMMER'L CONSUMP'N	MWH ESTIMATED COMMER'L HEATING	MWH TOTAL COMMER'L - HOUSES	ESTIMATED NO. OF ST LIGHTS	MWH ESTIMATED ST LIGHT CONSUMP'N
1980	6204	893	893	4643	0	0	4643	5745	0	10388	234	172
1981	6329	963	893	4457	70	341	4798	5888	0	10686	269	199
1982	6452	993	893	4881	100	522	5403	6087	0	11490	306	225
1983	6605	1018	893	4452	126	618	5071	6229	0	11300	282	206
1984	6759	1059	893	4452	166	818	5270	6370	0	11640	295	217
1985	6918	1100	893	4452	207	1024	5476	6516	0	11992	308	226
1986	7081	1145	893	4452	252	1253	5705	6667	0	12372	320	235
1987	7246	1191	918	4953	272	1393	6346	6720	283	13449	335	246
1988	7419	1240	941	6030	299	1772	7802	6976	1313	16091	350	257
1989	7592	1289	1019	7669	270	2029	9698	7136	3037	19873	365	268
1990	7770	1343	1019	8516	324	2691	11207	7305	4840	23350	381	281
1991	7953	1465	1019	9637	446	4192	13829	7470	6725	28024	416	306
1992	8140	1498	1019	10872	479	5118	15598	7641	9691	32320	426	313
1993	8331	1534	1019	11888	515	5953	17851	7817	10747	36215	436	320
1994	8526	1570	1019	11926	551	6495	18421	7998	12892	39311	448	330
1995	8727	1608	1019	11926	589	6942	18868	8181	15136	42185	458	335
1996	8933	1646	1019	11926	627	7387	19313	8369	15892	43574	468	344
1997	9143	1683	1019	11926	684	7820	19746	8563	16256	44567	478	352
1998	9356	1722	1019	11926	703	8278	20204	8757	16631	45592	490	360
1999	9577	1763	1019	11926	744	8758	20684	8961	17013	46658	503	369
2000	9803	1805	1019	11926	786	9253	21179	9167	17405	47751	514	378
2001	10032	1849	1019	11926	830	9768	21694	9378	17808	48878	526	386
2002	10258	1892	1019	11926	873	10273	22199	9593	18213	50005	538	396
2003	10510	1937	1019	11926	916	10802	22728	9813	18635	51176	552	407
2004	10758	1982	1019	11926	963	11330	23256	10038	19062	52356	564	414
2005	11008	2027	1019	11926	1008	11858	23784	10271	19501	53556	577	423
2006	11267	2074	1019	11926	1055	12409	24335	10508	19950	54791	590	434
2007	11532	2124	1019	11926	1105	12997	24923	10748	20407	56078	606	446
2008	11803	2173	1019	11926	1154	13571	25497	10998	20878	57371	618	454
2009	12081	2226	1019	11926	1207	14192	26118	11248	21357	58723	634	466
2010	12365	2276	1019	11926	1257	14778	26704	11508	21848	60058	646	476
2011	12655	2331	1019	11926	1312	15424	27350	11770	22350	61470	664	487
2012	12954	2386	1019	11926	1367	16070	27996	12042	22865	62903	679	500
2013	13257	2441	1019	11926	1422	16716	28642	12319	23391	64352	695	511
2014	13568	2499	1019	11926	1480	17397	29323	12603	23928	65854	711	522
2015	13887	2557	1019	11926	1538	18076	30002	12892	24479	67373	728	535

STUDY:ISLKIDEE; CALC:CENTRAL; TBL:C1; CASES: GHILL GLN GRIV OXH RSL STP WAS

ISLAND LAKE AREA ENERGY FORECAST 1980/81 TO 2015/16
GARDENHILL ,2.35 PCT POP. GROWTH, 6.85 TO 5.43 PRS PER HOUSE
PLUS:GODS LAKE NARROWS ,2.35 PCT POP. GROWTH,6.986 TO 5.43 PRS PER HOUS
PLUS:GODS RIVER ,2.35 PCT POP. GROWTH,6.44 TO 5.43 PRS PER HOUSE
PLUS:OXFORD HOUSE ,2.35 PCT POP. GROWTH,5.856 TO 5.43 PRS PER HOUSE
PLUS:RED SUCKER LAKE ,2.35 PCT POP. GROWTH,7.32 TO 5.43 PRS PER HOUSE
PLUS:STE THERESA POINT,2.35 PCT POP. GROWTH,8.391 TO 5.43 PRS PER HOUSE
PLUS:WASAGAMACH ,2.35 PCT POP GROWTH ,7.593 TO 5.43 PRS PER HOUSE
CENTRAL SYSTEM SUPPLY - NO RESIDENTIAL ELECTRICHEAT
TABLE 2A
BASE YEAR 1980

YEAR	MWH TOTAL HOUSE CONSUMP'N	FED LIGHTING LOAD MWH	PROV LIGHTING LOAD MWH	OTHER LIGHTING LOAD MWH	FED HEATING LOAD MWH	PROV HEATING LOAD MWH	OTHER HEATING LOAD MWH	MWH TOTAL C + N + S CONSUMP'N	PEAK DEMAND KW
1980	4643	4045	425	1278	0	0	0	10560	2411
1981	4798	4146	435	1307	0	0	0	10885	2485
1982	5403	4285	450	1352	0	0	0	11715	2675
1983	5071	4363	460	1383	0	0	0	11508	2628
1984	5270	4484	472	1414	0	0	0	11857	2708
1985	5476	4587	482	1448	0	0	0	12218	2786
1986	5705	4695	493	1479	0	0	0	12607	2878
1987	6346	4802	505	1515	238	17	28	13695	3290
1988	7802	4912	516	1548	1102	79	131	16348	4364
1989	9698	5025	529	1584	2551	182	304	20141	5747
1990	11207	5142	540	1620	4064	291	483	23831	6745
1991	13829	5258	552	1658	5647	404	672	28330	8084
1992	15598	5380	566	1697	7300	520	871	32633	9314
1993	17851	5504	578	1735	9029	645	1075	36535	10428
1994	18421	5631	591	1778	10830	773	1289	39641	11313
1995	18868	5758	605	1815	12713	907	1512	42520	12134
1996	19313	5892	619	1857	13350	954	1589	43918	12533
1997	19746	6028	633	1900	13854	976	1627	44919	12819
1998	20204	6168	647	1944	13970	989	1663	45952	13113
1999	20684	6308	662	1988	14292	1022	1701	47027	13421
2000	21179	6454	678	2038	14620	1045	1740	48129	13736
2001	21694	6600	695	2081	14958	1068	1780	49284	14060
2002	22199	6753	710	2130	15298	1093	1823	50401	14383
2003	22728	6909	727	2178	15653	1118	1864	51583	14721
2004	23256	7067	743	2228	16011	1144	1907	52770	15060
2005	23784	7230	760	2280	16381	1170	1949	53979	15408
2006	24335	7388	778	2333	16755	1198	1994	55225	15760
2007	24923	7567	796	2388	17144	1225	2040	56524	16131
2008	25497	7740	812	2442	17536	1253	2087	57825	16502
2009	26118	7919	833	2497	17941	1280	2135	59189	16892
2010	26704	8100	850	2553	18353	1310	2185	60534	17276
2011	27350	8288	870	2614	18775	1341	2235	61957	17681
2012	27996	8478	890	2673	19206	1372	2287	63403	18095
2013	28642	8673	912	2735	19647	1408	2338	64863	18512
2014	29323	8872	933	2798	20101	1435	2393	66278	18943
2015	30002	9078	954	2862	20562	1469	2448	67908	19380

STUDY:ISLKIDEE; CALC:CENTRAL; TBL:C1A; CASES: GHILL GLN GRIV OXH RSL STP WAS

TABLE 2-9 - CASE 2

PLUS:GODS LAKE NARROWS ,2.35 PCT POP. GROWTH,6.986 TO 5.43 PRS PER HOUS
PLUS:GODS RIVER ,2.35 PCT POP. GROWTH,6.44 TO 5.43 PRS PER HOUSE
PLUS:OXFORD HOUSE ,2.35 PCT POP. GROWTH,5.856 TO 5.43 PRS PER HOUSE
PLUS:RED SUCKER LAKE ,2.35 PCT POP. GROWTH,7.32 TO 5.43 PRS PER HOUSE
PLUS:STE THERESA POINT,2.35 PCT POP. GROWTH,8.391 TO 5.43 PRS PER HOUSE
PLUS:WASAGAMACH ,2.35 PCT POP GROWTH ,7.593 TO 5.43 PRS PER HOUSE
CENTRAL SYSTEM SUPPLY- NO ESC. ON COMMERCIAL HEAT
TABLE 2
BASE YEAR 1980

YEAR	ESTIMATED POPUL'N	REQ'D HOUSES	OLD HOUSES	MWH CONSUMP'N OLD HOUSES	NEW HOUSES	MWH CONSUMP'N NEW HOUSES	MWH TOTAL HOUSE CONSUMP'N	MWH ESTIMATED COMMER'L CONSUMP'N	MWH ESTIMATED COMMER'L HEATING	MWH TOTAL COMMER'L + HOUSES	ESTIMATED NO. OF ST LIGHTS	MWH ESTIMATED ST LIGHT CONSUMP'N
1980	6204	893	893	4843	0	0	4843	5745	0	10388	234	172
1981	6328	963	893	4457	70	341	4798	5888	0	10686	269	198
1982	6452	993	893	4881	100	522	5403	6087	0	11490	306	225
1983	6605	1019	893	4452	126	819	5071	6229	0	11300	282	208
1984	6759	1059	893	4452	166	818	5270	6370	0	11640	295	217
1985	6918	1100	893	4452	207	1024	5478	6516	0	11992	308	228
1986	7081	1145	893	4452	252	1253	5705	6667	0	12372	320	235
1987	7248	1191	919	4953	272	1697	6650	6820	283	13753	335	246
1988	7419	1240	941	6030	299	3887	9917	6976	1300	18193	350	257
1989	7592	1289	1019	7869	270	6246	14015	7138	2964	24117	365	268
1990	7770	1343	1019	8516	324	7616	16132	7303	4628	28063	381	281
1991	7953	1405	1019	9627	446	10483	20120	7470	6291	33881	416	308
1992	8140	1498	1019	10872	479	11258	22130	7641	7955	37726	428	313
1993	8331	1534	1019	11698	515	12105	23803	7817	9621	41241	436	320
1994	8526	1570	1019	11926	551	12950	24876	7998	11285	44159	448	330
1995	8727	1608	1019	11926	589	13843	25769	8181	12965	46915	458	335
1996	8933	1646	1019	11926	627	14735	26661	8369	13313	48343	468	344
1997	9143	1683	1019	11926	664	15605	27531	8563	13313	49407	478	352
1998	9356	1722	1019	11926	703	16522	28448	8757	13313	50518	490	360
1999	9577	1763	1019	11926	744	17484	29410	8961	13313	51684	503	369
2000	9803	1805	1019	11926	788	18474	30400	9167	13313	52880	514	378
2001	10032	1849	1019	11926	830	19508	31434	9378	13313	54125	528	386
2002	10268	1892	1019	11926	873	20517	32443	9593	13313	55349	538	396
2003	10510	1937	1019	11926	918	21574	33500	9813	13313	56626	552	407
2004	10758	1982	1019	11926	963	22633	34559	10038	13313	57910	564	414
2005	11008	2027	1019	11926	1008	23690	35616	10271	13313	59200	577	423
2006	11267	2074	1019	11926	1055	24794	36720	10506	13313	60539	590	434
2007	11532	2124	1019	11926	1105	25970	37896	10748	13313	61957	606	446
2008	11803	2173	1019	11926	1154	27121	39047	10996	13313	63356	618	454
2009	12081	2226	1019	11926	1207	28367	40293	11248	13313	64854	634	466
2010	12365	2276	1019	11926	1257	29541	41467	11506	13313	66288	646	478
2011	12655	2331	1019	11926	1312	30834	42760	11770	13313	67843	664	487
2012	12954	2386	1019	11926	1367	32127	44053	12042	13313	69408	679	500
2013	13257	2441	1019	11926	1422	33419	45345	12319	13313	70977	695	511
2014	13568	2499	1019	11926	1480	34782	46708	12603	13313	72524	711	522
2015	13887	2557	1019	11926	1538	36145	48071	12892	13313	74276	728	535

STUDY:ISLKIDEM; CALC:CENTRAL; TBL:C1; CASES: GHILL GLN GRIV OXH RSL STP LAS

ISLAND LAKE AREA ENERGY FORECAST 1980/81 TO 2015/16
GARDENHILL ,2.35 PCT POP. GROWTH, 6.85 TO 5.43 PRS PER HOUSE
PLUS:GODS LAKE NARROWS ,2.35 PCT POP. GROWTH,6.986 TO 5.43 PRS PER HOUS
PLUS:GODS RIVER ,2.35 PCT POP. GROWTH,6.44 TO 5.43 PRS PER HOUSE
PLUS:OXFORD HOUSE ,2.35 PCT POP. GROWTH,5.856 TO 5.43 PRS PER HOUSE
PLUS:RED SUCKER LAKE ,2.35 PCT POP. GROWTH,7.32 TO 5.43 PRS PER HOUSE
PLUS:STE THERESA POINT,2.35 PCT POP. GROWTH,8.391 TO 5.43 PRS PER HOUSE
PLUS:WASAGAMACH ,2.35 PCT POP GROWTH ,7.593 TO 5.43 PRS PER HOUSE
CENTRAL SYSTEM SUPPLY- NO ESC. ON COMMERCIAL HEAT
TABLE 2A
BASE YEAR 1980

YEAR	MWH TOTAL HOUSE CONSUMP'N	FED LIGHTING LOAD MWH	PROV LIGHTING LOAD MWH	OTHER LIGHTING LOAD MWH	FED HEATING LOAD MWH	PROV HEATING LOAD MWH	OTHER HEATING LOAD MWH	MWH TOTAL C + N + S CONSUMP'N	PEAK DEMAND KW
1980	4843	4045	425	1276	0	0	0	10588	2411
1981	4798	4148	435	1307	0	0	0	10885	2485
1982	5403	4285	450	1352	0	0	0	11715	2675
1983	5071	4383	460	1383	0	0	0	11508	2528
1984	5270	4484	472	1414	0	0	0	11957	2708
1985	5478	4587	482	1446	0	0	0	12218	2788
1986	5705	4695	493	1479	0	0	0	12607	2978
1987	6650	4802	505	1515	238	17	28	13999	3377
1988	9917	4912	516	1548	1091	78	130	19450	4563
1989	14015	5025	529	1584	2490	178	297	24385	5360
1990	16132	5142	540	1620	3888	278	463	28344	6224
1991	20120	5258	552	1658	5284	378	629	34187	7751
1992	22130	5380	566	1697	6682	478	795	38039	10856
1993	23803	5504	578	1735	8080	577	962	41561	11852
1994	24876	5631	591	1776	9478	677	1129	44483	12698
1995	25769	5758	605	1815	10891	778	1298	47250	13484
1996	26661	5892	619	1857	11183	799	1332	48687	13895
1997	27531	6028	633	1900	11183	799	1332	49759	14200
1998	28448	6166	647	1944	11183	799	1332	50879	14520
1999	29410	6308	662	1989	11183	799	1332	52053	14855
2000	30400	6454	678	2036	11183	799	1332	53258	15200
2001	31434	6600	695	2081	11183	799	1332	54511	15557
2002	32443	6753	710	2130	11183	799	1332	55745	15909
2003	33500	6909	727	2179	11183	799	1332	57033	16277
2004	34559	7067	743	2228	11183	799	1332	58324	16646
2005	35616	7230	760	2280	11183	799	1332	59623	17015
2006	36720	7398	778	2333	11183	799	1332	60973	17400
2007	37898	7567	796	2386	11183	799	1332	62403	17808
2008	39047	7740	812	2442	11183	799	1332	63810	18211
2009	40293	7919	833	2497	11183	799	1332	65320	18641
2010	41467	8100	850	2553	11183	799	1332	66762	19052
2011	42760	8286	870	2614	11183	799	1332	68330	19501
2012	44053	8478	890	2673	11183	799	1332	71488	20403
2013	45345	8673	912	2735	11183	799	1332	73146	20875
2014	46708	8872	933	2798	11183	799	1332	74811	21351
2015	48071	9076	954	2862	11183	799	1332		

STUDY:ISLKIDEM; CALC:CENTRAL; TBL:C1A; CASES: GHILL GLN GRIV OXH RSL STP WAS

TABLE 2-10 - CASE 3

ISLAND LAKE AREA ENERGY FORECAST 1980/81 TO 2015/16
GARDENHILL ,2.35 PCT POP. GROWTH, 6.85 TO 5.70 PRS PER HOUSE
PLUS:GODS LAKE NARROWS ,2.35 PCT POP. GROWTH,6.986 TO 5.70 PRS PER HOUS
PLUS:GODS RIVER ,2.35 PCT POP. GROWTH,6.44 TO 5.70 PRS PER HOUSE
PLUS:OXFORD HOUSE ,2.35 PCT POP. GROWTH,5.856 TO 5.70 PRS PER HOUSE
PLUS:RED SUCKER LAKE ,2.35 PCT POP. GROWTH,7.32 TO 5.70 PRS PER HOUSE
PLUS:STE THERESA POINT,2.35 PCT POP. GROWTH,8.391 TO 5.70 PRS PER HOUSE
PLUS:WASAGAMACH ,2.35 PCT POP GROWTH ,7.593 TO 5.70 PRS PER HOUSE
CENTRAL SYSTEM SUPPLY
TABLE 2
BASE YEAR 1980

YEAR	ESTIMATED POPUL'N	REQ'D HOUSES	OLD HOUSES	MWH CONSUMP'N OLD HOUSES	NEW HOUSES	MWH CONSUMP'N NEW HOUSES	MWH TOTAL HOUSE CONSUMP'N	MWH ESTIMATED COMMER'L CONSUMP'N	MWH ESTIMATED COMMER'L HE-:::w	MWH TOTAL COMMER'L HOUSES	ESTIMATED NO. OF ST LIGHTS	MWH ESTIMATED ST LIGHT CONSUMP'N
1980	6204	893	893	4843	0	0	4843	5745	0	10388	234	172
1981	6328	963	893	4857	70	341	4798	5888	0	10686	269	199
1982	6452	993	893	4881	100	522	5403	6087	0	11490	306	225
1983	6605	1019	893	4452	128	619	5071	6229	0	11300	282	208
1984	6759	1059	893	4452	166	818	5270	6370	0	11640	295	217
1985	6918	1100	893	4452	207	1024	5476	6516	0	11992	308	226
1986	7081	1145	893	4452	252	1253	5705	6667	0	12372	320	235
1987	7246	1191	919	4953	272	1697	6650	6820	283	13753	335	246
1988	7419	1240	941	6030	299	3887	9917	6976	1313	18206	350	257
1989	7592	1289	1019	7669	270	6346	14015	7138	3037	24180	365	269
1990	7770	1343	1019	8516	324	7616	16132	7303	4840	28275	381	281
1991	7953	1395	1019	9637	376	8838	18475	7470	5725	32670	397	292
1992	8140	1428	1019	10872	409	9615	20487	7641	8691	35819	415	305
1993	8331	1461	1019	11698	442	10388	22086	7817	10747	40650	428	311
1994	8526	1495	1019	11926	476	11189	23115	7998	12892	44005	438	320
1995	8727	1531	1019	11926	512	12035	23961	8181	15136	47278	448	330
1996	8933	1568	1019	11926	549	12904	24830	8369	15892	49091	458	335
1997	9143	1603	1019	11926	584	13727	25653	8563	16258	50474	467	343
1998	9356	1642	1019	11926	623	14643	26569	8757	16631	51957	477	351
1999	9577	1680	1019	11926	681	15535	27461	8961	17013	53435	490	360
2000	9803	1720	1019	11926	701	16475	28401	9167	17405	54973	501	367
2001	10032	1760	1019	11926	741	17415	29341	9378	17806	56525	511	375
2002	10268	1800	1019	11926	781	18355	30281	9593	18213	58087	526	388
2003	10510	1845	1019	11926	826	19413	31339	9813	18635	59787	538	396
2004	10758	1887	1019	11926	868	20400	32326	10038	19062	61426	549	406
2005	11008	1932	1019	11926	913	21457	33383	10271	19501	63155	564	414
2006	11267	1976	1019	11926	957	22490	34416	10506	19950	64872	576	422
2007	11532	2023	1019	11926	1004	23596	35522	10748	20407	66677	590	434
2008	11803	2070	1019	11926	1051	24700	36626	10996	20878	68500	604	444
2009	12081	2121	1019	11926	1102	25900	37826	11248	21357	70431	616	454
2010	12365	2168	1019	11926	1149	27004	38930	11506	21848	72284	632	465
2011	12655	2221	1019	11926	1202	28249	40175	11770	22350	74295	646	476
2012	12954	2273	1019	11926	1254	29471	41397	12042	22665	78304	661	484
2013	13257	2325	1019	11926	1306	30692	42618	12319	23391	78228	678	499
2014	13568	2379	1019	11926	1360	31963	43889	12603	23628	80420	694	511
2015	13887	2436	1019	11926	1417	33302	45228	12892	24479	82539		

STUDY::ISLKIDEB; CALC:CENTRAL; TBL:C1; CASES: GHILL GLN GRIV OXH RSL STP WAS

ISLAND LAKE AREA ENERGY FORECAST 1980/81 TO 2015/16
GARDENHILL ,2.35 PCT POP. GROWTH, 6.85 TO 5.70 PRS PER HOUSE
PLUS:GODS LAKE NARROWS ,2.35 PCT POP. GROWTH,6.986 TO 5.70 PRS PER HOUS
PLUS:GODS RIVER ,2.35 PCT POP. GROWTH,6.44 TO 5.70 PRS PER HOUSE
PLUS:OXFORD HOUSE ,2.35 PCT POP. GROWTH,5.856 TO 5.70 PRS PER HOUSE
PLUS:RED SUCKER LAKE ,2.35 PCT POP. GROWTH,7.32 TO 5.70 PRS PER HOUSE
PLUS:STE THERESA POINT,2.35 PCT POP. GROWTH,8.391 TO 5.70 PRS PER HOUSE
PLUS:WASAGAMACH ,2.35 PCT POP GROWTH ,7.593 TO 5.70 PRS PER HOUSE
CENTRAL SYSTEM SUPPLY
TABLE 2A
BASE YEAR 1980

YEAR	MWH TOTAL HOUSE CONSUMP'N	FED LIGHTING LOAD MWH	PROV LIGHTING LOAD MWH	OTHER LIGHTING LOAD MWH	FED HEATING LOAD MWH	PROV HEATING LOAD MWH	OTHER HEATING LOAD MWH	MWH TOTAL C - M - S CONSUMP'N	PEAK DEMAND KW
1980	4843	4045	425	1276	0	0	0	10588	2411
1981	4798	4146	435	1307	0	0	0	10886	2485
1982	5403	4285	450	1352	0	0	0	11490	2628
1983	5071	4383	460	1383	0	0	0	11300	2703
1984	5270	4484	472	1414	0	0	0	11640	2788
1985	5476	4587	482	1446	0	0	0	11992	2878
1986	5705	4695	493	1479	0	0	0	12372	2977
1987	6650	4802	505	1515	238	17	28	13753	4667
1988	9917	4912	518	1548	1102	79	131	18207	6980
1989	14015	5025	529	1584	2551	182	304	24458	9149
1990	16132	5142	540	1620	4064	291	483	28556	9408
1991	18475	5258	552	1658	5647	404	672	32662	10553
1992	20487	5380	566	1697	7300	520	871	37119	11688
1993	22088	5504	578	1735	9029	645	1075	40955	12647
1994	23115	5631	591	1778	10830	773	1289	44316	13583
1995	23961	5758	605	1815	12713	907	1512	47598	14105
1996	24830	5892	619	1857	13350	954	1589	48421	14489
1997	25653	6028	633	1900	13654	976	1627	50809	14928
1998	26569	6168	647	1944	13970	999	1663	52300	15350
1999	27461	6308	665	1989	14292	1022	1701	53788	15781
2000	28401	6454	678	2036	14620	1045	1740	55333	16237
2001	29341	6600	695	2081	14956	1068	1780	58862	16885
2002	30281	6753	710	2130	15299	1093	1822	58462	17173
2003	31338	6909	727	2179	15653	1119	1864	60173	17644
2004	32326	7067	743	2228	16011	1144	1907	61822	18139
2005	33383	7230	760	2280	16381	1170	1949	63561	18631
2006	34416	7396	778	2333	16755	1198	1994	65286	19149
2007	35522	7567	795	2386	17144	1225	2040	67099	19673
2008	36626	7740	812	2442	17538	1253	2087	68934	20228
2009	37826	7919	833	2497	17941	1280	2135	70875	20759
2010	38930	8100	850	2553	18353	1310	2185	72738	21337
2011	40175	8288	870	2614	18775	1341	2235	74760	21913
2012	41397	8478	890	2673	19208	1372	2287	76780	22492
2013	42618	8673	912	2735	19647	1406	2338	78812	23093
2014	43889	8872	933	2798	20101	1435	2393	80919	23719
2015	45228	9076	954	2862	20562	1469	2447	83110	

STUDY:ISLKIDEB; CALC:CENTRAL; TBL:C1A; CASES: GHILL GLN GRIV OXH RS STP WAS

TABLE 2-11 - CASE 4

ISLAND LAKE AREA ENERGY FORECAST 1980/81 TO 2015/16
GARDENHILL ,2.35 PCT POP. GROWTH, 6.85 TO 5.70 PRS PER HOUSE
PLUS:GODS LAKE NARROWS ,2.35 PCT POP. GROWTH,6.986 TO 5.70 PRS PER HOUS
PLUS:GODS RIVER ,2.35 PCT POP. GROWTH,6.44 TO 5.70 PRS PER HOUSE
PLUS:OXFORD HOUSE ,2.35 PCT POP. GROWTH,5.856 TO 5.70 PRS PER HOUSE
PLUS:RED SUCKER LAKE ,2.35 PCT POP. GROWTH,7.32 TO 5.70 PRS PER HOUSE
PLUS:STE THERESA POINT,2.35 PCT POP. GROWTH,8.391 TO 5.70 PRS PER HOUSE
PLUS:WASAGAMACH ,2.35 PCT POP GROWTH ,7.593 TO 5.70 PRS PER HOUSE
CENTRAL SYSTEM SUPPLY - NO RESIDENTIAL ELECTRICHEAT

TABLE 2
BASE YEAR 1980

YEAR	ESTIMATED POPUL'N	REQ'D HOUSES	OLD HOUSES	MWH CONSUMP'N OLD HOUSES	NEW HOUSES	MWH CONSUMP'N NEW HOUSES	MWH TOTAL HOUSE CONSUMP'N	MWH ESTIMATED COMMER'L CONSUMP'N	MWH ESTIMATED COMMER'L HEATING	MWH TOTAL COMMER'L + HOUSES	ESTIMATED NO. OF ST LIGHTS	MWH ESTIMATED ST LIGHT CONSUMP'N
1980	6204	893	893	4643	0	0	4643	5745	0	10388	234	172
1981	6328	963	893	4657	70	341	4798	5888	0	10686	269	199
1982	6452	993	893	4881	100	522	5403	6087	0	11490	308	225
1983	6605	1019	893	4452	126	819	5271	6229	0	11500	282	208
1984	6759	1059	893	4452	166	818	5270	6370	0	11640	295	217
1985	6918	1100	893	4452	207	1024	5478	6516	0	11992	308	226
1986	7081	1145	893	4452	252	1253	5705	6667	0	12372	320	235
1987	7246	1191	919	4953	272	1393	6346	6820	293	13459	335	246
1988	7419	1240	941	6030	299	1772	7802	6978	1313	16093	350	257
1989	7592	1289	1019	7669	270	2029	9698	7138	3037	19873	365	268
1990	7770	1343	1019	8516	324	2691	11207	7470	4640	23353	381	281
1991	7953	1395	1019	9637	376	3530	13167	7641	8591	31575	407	300
1992	8140	1428	1019	10872	409	4371	15243	7817	10747	35374	415	305
1993	8331	1461	1019	11698	442	5112	16810	7998	12892	38430	426	311
1994	8526	1495	1019	11926	476	5614	17540	8181	15136	41281	436	320
1995	8727	1531	1019	11926	512	6038	17964	8369	15892	42659	448	330
1996	8933	1568	1019	11926	549	6472	18398	8563	16258	43630	456	335
1997	9143	1603	1019	11926	584	6883	18809	8757	16631	44654	467	343
1998	9355	1642	1019	11926	623	7340	19266	8957	17013	45685	477	351
1999	9577	1680	1019	11926	661	7785	19711	8961	17405	48753	490	360
2000	9803	1720	1019	11926	701	8255	20181	9167	17806	47832	501	367
2001	10032	1760	1019	11926	741	8722	20648	9378	17806	48928	511	375
2002	10258	1800	1019	11926	781	9194	21120	9593	18213	50096	526	386
2003	10510	1845	1019	11926	826	9722	21648	9813	18635	51241	538	396
2004	10758	1887	1019	11926	868	10215	22141	10038	19062	51241	549	406
2005	11008	1932	1019	11926	913	10742	22668	10271	19501	52440	564	414
2006	11267	1976	1019	11926	957	11259	23185	10508	19950	53641	576	422
2007	11532	2023	1019	11926	1004	11811	23737	10748	20407	54892	590	434
2008	11803	2070	1019	11926	1051	12363	24289	10996	20878	56163	604	444
2009	12081	2121	1019	11926	1102	12962	24888	11246	21357	57493	618	454
2010	12365	2168	1019	11926	1149	13511	25437	11506	21648	58791	632	465
2011	12655	2221	1019	11926	1202	14134	26060	11770	22350	60180	648	476
2012	12954	2273	1019	11926	1254	14744	26670	12042	22655	61577	661	484
2013	13257	2325	1019	11926	1306	15352	27278	12319	23391	62988	678	499
2014	13568	2379	1019	11926	1360	15988	27914	12603	23528	64445	694	511
2015	13887	2436	1019	11926	1417	16655	28581	12892	24479	65952		

STUDY:ISLKIDEC; CALC:CENTRAL; TBL:C1; CASES: GHILL GLN GRIV OXH PSL STP LWS

ISLAND LAKE AREA ENERGY FORECAST 1980/81 TO 2015/16
GARDENHILL ,2.35 PCT POP. GROWTH, 6.85 TO 5.70 PRS PER HOUSE
PLUS:GODS LAKE NARROWS ,2.35 PCT POP. GROWTH,6.986 TO 5.70 PRS PER HOUS
PLUS:GODS RIVER ,2.35 PCT POP. GROWTH,6.44 TO 5.70 PRS PER HOUSE
PLUS:OXFORD HOUSE ,2.35 PCT POP. GROWTH,5.856 TO 5.70 PRS PER HOUSE
PLUS:RED SUCKER LAKE ,2.35 PCT POP. GROWTH,7.32 TO 5.70 PRS PER HOUSE
PLUS:STE THERESA POINT,2.35 PCT POP. GROWTH,8.391 TO 5.70 PRS PER HOUSE
PLUS:WASAGAMACH ,2.35 PCT POP GROWTH ,7.593 TO 5.70 PRS PER HOUSE
CENTRAL SYSTEM SUPPLY - NO RESIDENTIAL ELECTRICHEAT

TABLE 2A
BASE YEAR 1980

YEAR	MWH TOTAL HOUSE CONSUMP'N	FED LIGHTING LOAD MW	PROV LIGHTING LOAD MW	OTHER LIGHTING LOAD MW	FED HEATING LOAD MW	PROV HEATING LOAD MW	OTHER HEATING LOAD MW	MWH TOTAL C + M + S CONSUMP'N	PEAK DEMAND KW
1980	4643	4045	425	1278	0	0	0	10560	2411
1981	4798	4145	435	1307	0	0	0	10885	2485
1982	5403	4285	450	1352	0	0	0	11716	2676
1983	5271	4383	460	1383	0	0	0	11508	2626
1984	5270	4494	472	1414	0	0	0	11857	2706
1985	5478	4587	482	1446	0	0	0	12118	2788
1986	5705	4695	493	1479	0	0	0	12420	2878
1987	6346	4802	505	1515	238	17	28	13649	3290
1988	7802	4922	516	1548	1102	79	131	16749	4364
1989	9698	5042	529	1584	2551	182	304	20141	5747
1990	11207	5142	540	1620	4064	291	483	23631	6745
1991	13167	5258	552	1658	5647	404	672	27654	7892
1992	15243	5380	566	1697	7300	520	871	31875	9098
1993	16810	5504	578	1735	9029	645	1075	35679	10183
1994	17540	5631	591	1776	10830	773	1289	38741	11055
1995	17964	5758	605	1815	12713	907	1512	41601	11872
1996	18398	5892	619	1857	13350	954	1589	42989	12270
1997	18809	6028	633	1900	13654	978	1627	43985	12548
1998	19266	6166	647	1944	13970	999	1663	44997	12840
1999	19711	6308	665	1989	14292	1022	1701	46036	13136
2000	20181	6454	678	2036	14620	1045	1740	47113	13445
2001	20648	6600	695	2081	14956	1068	1780	48199	13755
2002	21120	6753	710	2130	15299	1093	1823	49301	14070
2003	21648	6909	727	2179	15653	1119	1864	50482	14407
2004	22141	7067	743	2226	16011	1144	1907	51637	14736
2005	22668	7230	760	2280	16381	1170	1949	52848	15083
2006	23185	7396	778	2333	16755	1198	1994	54055	15427
2007	23737	7567	796	2386	17144	1225	2040	55314	15785
2008	24289	7740	812	2442	17538	1253	2087	56597	16152
2009	24859	7919	833	2497	17941	1280	2135	57937	16533
2010	25437	8100	850	2553	18353	1310	2185	59245	16908
2011	26060	8286	870	2614	18775	1341	2235	60645	17308
2012	26670	8478	890	2673	19208	1372	2287	62053	17709
2013	27278	8673	912	2735	19647	1406	2338	63472	18114
2014	27914	8872	933	2798	20101	1435	2393	64944	18534
2015	28581	9076	954	2862	20562	1469	2448	66463	18966

STUDY:ISLKIDEC; CALC:CENTRAL; TBL:C1A; CASES: GHILL GLN GRIV OXH PSL STP LWS

TABLE 2-12 - CASE 5

ISLAND LAKE AREA ENERGY FORECAST 1980/81 TO 2015/16
GARDEN HILL ,3-0 PCT POP. GROWTH, 7.10 TO 5.43 PRS PER HOUSE
PLUS:GODS LAKE NARROWS ,3.00 PCT POP. GROWTH,6.986 TO 5.43 PRS PER HOUSE
PLUS:GODS RIVER ,3.00 PCT POP. GROWTH,6.41 TO 5.43 PRS PER HOUSE
PLUS:OXFORD HOUSE ,3.00 PCT POP. GROWTH,5.757 TO 5.43 PRS PER HOUSE
PLUS:RED SUCKER LAKE ,3.00 PCT POP. GROWTH,7.32 TO 5.43 PRS PER HOUSE
PLUS:STE THERESA POINT,3.00 PCT POP. GROWTH,8.391 TO 5.43 PRS PER HOUSE
PLUS:WASAGAMACH ,3.00 PCT POP GROWTH ,7.488 TO 5.43 PRS PER HOUSE
CENTRAL SYSTEM SUPPLY
TABLE 2
BASE YEAR 1980

YEAR	ESTIMATED POPUL'N	REQ'D HOUSES	OLD HOUSES	MWH CONSUMP'N OLD HOUSES	NEW HOUSES	MWH CONSUMP'N NEW HOUSES	MWH TOTAL HOUSE CONSUMP'N	MWH ESTIMATED COMMER'L CONSUMP'N	MWH ESTIMATED COMMER'L HEATING	MWH TOTAL COMMER'L + MUNISES	ESTIMATED NO. OF ST LIGHTS	MWH ESTIMATED ST LIGHT CONSUMP'N
1980	6204	893	893	4643	0	0	4643	5745	0	10388	234	172
1981	6390	963	893	4457	70	341	4798	5888	0	10686	269	199
1982	6581	997	893	4881	104	542	5423	6087	0	11510	307	226
1983	6779	1043	893	4452	150	742	5194	6229	0	11423	292	213
1984	6982	1092	893	4452	199	988	5440	6370	0	11810	308	227
1985	7193	1143	893	4452	250	1244	5696	6516	0	12212	322	236
1986	7408	1197	893	4452	304	1514	5966	6667	0	12633	339	249
1987	7630	1253	912	4906	341	2138	7044	6820	283	14147	356	261
1988	7860	1311	1030	7131	281	5666	12997	6976	1800	21773	374	275
1989	8094	1374	1043	8067	331	7781	15848	7139	3464	26450	394	290
1990	8338	1439	1043	8950	396	9306	18258	7303	5128	30689	413	303
1991	8588	1582	1043	10253	539	12667	22920	7470	6791	37181	455	334
1992	8844	1629	1043	11590	586	13773	25363	7641	8455	41459	489	345
1993	9110	1678	1043	12159	635	14925	27084	7817	10122	45023	483	354
1994	9384	1729	1043	12216	686	16123	28339	7998	11985	48322	497	364
1995	9667	1781	1043	12216	738	17344	29560	8181	13265	51006	513	376
1996	9955	1832	1043	12216	789	18542	30758	9369	13313	52440	528	389
1997	10255	1889	1043	12216	846	19882	32098	8563	13313	53974	543	400
1998	10562	1944	1043	12216	901	21175	33391	8757	13313	55461	560	411
1999	10878	2002	1043	12216	959	22539	34755	8961	13313	57029	576	423
2000	11205	2064	1043	12216	1021	23997	36213	9167	13313	58693	593	437
2001	11541	2125	1043	12216	1082	25429	37645	9378	13313	60336	610	449
2002	11888	2189	1043	12216	1146	26933	39149	9593	13313	62055	630	463
2003	12245	2255	1043	12216	1212	28483	40699	9813	13313	63825	649	477
2004	12612	2321	1043	12216	1276	30034	42250	10038	13313	65601	666	489
2005	12990	2393	1043	12216	1350	31727	43943	10271	13313	67527	690	508
2006	13378	2464	1043	12216	1421	33396	45612	10506	13313	69431	709	521
2007	13781	2538	1043	12216	1495	35135	47351	10748	13313	71412	729	536
2008	14195	2614	1043	12216	1571	36921	49137	10996	13313	73446	753	554
2009	14621	2693	1043	12216	1650	38776	50992	11248	13313	75553	775	569
2010	15058	2773	1043	12216	1730	40656	52872	11506	13313	77891	799	587
2011	15512	2857	1043	12216	1814	42631	54847	11770	13313	79930	821	603
2012	15976	2941	1043	12216	1898	44606	56822	12042	13313	82177	845	622
2013	16456	3032	1043	12216	1989	46743	58959	12319	13313	84591	873	641
2014	16949	3121	1043	12216	2078	48834	61050	12603	13313	86966	898	661
2015	17457	3217	1043	12216	2174	51091	63307	12892	13313	89512	927	681

STUDY:ISLKIDEA; CALC:CENTRAL; TBL:C1; CASES: GHILL GLN GRIV OXH RSL STP WAS

ISLAND LAKE AREA ENERGY FORECAST 1980/81 TO 2015/16
GARDEN HILL ,3-0 PCT POP. GROWTH, 7.10 TO 5.43 PRS PER HOUSE
PLUS:GODS LAKE NARROWS ,3.00 PCT POP. GROWTH,6.986 TO 5.43 PRS PER HOUS
PLUS:GODS RIVER ,3.00 PCT POP. GROWTH,6.41 TO 5.43 PRS PER HOUSE
PLUS:OXFORD HOUSE ,3.00 PCT POP. GROWTH,5.757 TO 5.43 PRS PER HOUSE
PLUS:RED SUCKER LAKE ,3.00 PCT POP. GROWTH,7.32 TO 5.43 PRS PER HOUSE
PLUS:STE THERESA POINT,3.00 PCT POP. GROWTH,8.391 TO 5.43 PRS PER HOUSE
PLUS:WASAGAMACH ,3.00 PCT POP GROWTH ,7.488 TO 5.43 PRS PER HOUSE
CENTRAL SYSTEM SUPPLY
TABLE 2A
BASE YEAR 1980

YEAR	MWH TOTAL HOUSE CONSUMP'N	FED LIGHTING LOAD MWH	PROV LIGHTING LOAD MWH	OTHER LIGHTING LOAD MWH	FED HEATING LOAD MWH	PROV HEATING LOAD MWH	OTHER HEATING LOAD MWH	MWH TOTAL C + M + S CONSUMP'N	PEAK DEMAND KW
1980	4643	4045	425	1276	0	0	0	10580	2411
1981	4798	4146	435	1307	0	0	0	10885	2485
1982	5423	4285	450	1352	0	0	0	11736	2680
1983	5194	4383	460	1383	0	0	0	11636	2557
1984	5440	4494	472	1414	0	0	0	12037	2748
1985	5696	4587	481	1446	0	0	0	12448	2841
1986	5966	4695	493	1479	0	0	0	12882	2941
1987	7044	4802	505	1515	236	17	28	14408	3474
1988	12997	4913	516	1548	1511	108	180	22046	6212
1989	15848	5025	529	1584	2510	208	347	26740	7632
1990	18258	5142	540	1620	4338	308	513	30992	8844
1991	22920	5258	552	1658	5704	408	679	37515	10705
1992	25363	5380	566	1697	7102	508	846	41804	11930
1993	27084	5504	578	1735	8500	607	1012	45377	12950
1994	28339	5631	591	1776	10067	719	1198	48686	13893
1995	29560	5758	605	1815	11143	796	1328	51382	14664
1996	30758	5892	619	1857	11183	799	1332	52829	15076
1997	32098	6028	633	1900	11183	799	1332	54374	15518
1998	33391	6166	647	1944	11183	799	1332	55872	15944
1999	34755	6308	665	1989	11183	796	1332	57452	16397
2000	36213	6454	678	2036	11183	799	1332	59130	16874
2001	37645	6600	695	2081	11183	799	1332	60785	17347
2002	39149	6753	710	2130	11183	799	1332	62518	17841
2003	40699	6909	727	2179	11183	799	1332	64302	18352
2004	42250	7067	743	2228	11183	799	1332	66090	18861
2005	43943	7230	760	2280	11183	799	1332	68035	19416
2006	45612	7396	778	2333	11183	799	1332	69952	19965
2007	47351	7567	796	2388	11183	799	1332	71948	20533
2008	49137	7740	812	2442	11183	799	1332	74000	21119
2009	50992	7919	833	2497	11183	799	1332	76122	21724
2010	52872	8100	850	2553	11183	799	1332	78278	22340
2011	54847	8286	870	2614	11183	799	1332	80539	22982
2012	56822	8478	890	2673	11183	799	1332	82799	23630
2013	58959	8673	912	2735	11183	799	1332	85232	24324
2014	61050	8872	933	2798	11183	799	1332	87627	25009
2015	63307	9076	954	2862	11183	799	1332	90193	25740

STUDY:ISLAIDEA; CALC:CENTRAL; TBL:C1A; CASES: GHILL GLN GRIV OXH RSL STP WAS

TABLE 2-13 - CASE 6

ISLAND LAKE AREA ENERGY FORECAST 1980/81 TO 2015/16
GARDENHILL ,3-0 PCT POP. GROWTH, 7.10 TO 5.43 PRS PER HOUSE
PLUS:GODS LAKE NARROWS ,3.00 PCT POP. GROWTH,6.986 TO 5.43 PRS PER HOUS
PLUS:GODS RIVER ,3.00 PCT POP. GROWTH,6.41 TO 5.43 PRS PER HOUSE
PLUS:OXFORD HOUSE ,3.00 PCT POP. GROWTH,5.757 TO 5.43 PRS PER HOUSE
PLUS:RED SUCKER LAKE ,3.00 PCT POP. GROWTH,7.32 TO 5.43 PRS PER HOUSE
PLUS:STE THERESA POINT,3.00 PCT POP. GROWTH,8.391 TO 5.43 PRS PER HOUSE
PLUS:WASAGOMACH ,3.00 PCT POP GROWTH ,7.488 TO 5.43 PRS PER HOUSE
CENTRAL SYSTEM SUPPLY- NO RESIDENTIAL ELECTRIC HEAT
TABLE 2
BASE YEAR 1980

YEAR	ESTIMATED POPUL'N	REQ'D HOUSES	OLD HOUSES	KWH CONSUMP'N OLD HOUSES	NEW HOUSES	KWH CONSUMP'N NEW HOUSES	KWH TOTAL HOUSE CONSUMP'N	KWH ESTIMATED COMMER'L CONSUMP'N	KWH ESTIMATED COMMER'L HEATING	KWH TOTAL COMMER'L - HOUSES	ESTIMATED NO. OF ST LIGHTS	KWH ESTIMATED ST LIGHT CONSUMP'N
1980	6204	893	893	4643	0	0	4643	5745	0	10388	234	172
1981	6390	963	893	4457	70	341	4798	5888	0	10686	269	199
1982	6581	997	893	4881	104	542	5423	6087	0	11510	307	226
1983	6779	1043	893	4452	150	742	5194	6229	0	11423	292	213
1984	6982	1092	693	4452	199	988	5440	6370	0	11810	308	227
1985	7193	1143	893	4452	250	1244	5698	6518	0	12212	322	236
1986	7408	1197	693	4452	304	1514	5966	6667	0	12633	339	249
1987	7630	1253	912	4906	341	1750	6656	6820	283	13759	356	261
1988	7860	1311	1030	7131	281	1912	9043	6976	1800	17819	374	275
1989	8094	1374	1043	9067	331	2559	10626	7128	3464	21228	394	290
1990	8338	1439	1043	8950	396	3398	12338	7302	5128	24767	413	303
1991	8586	1502	1043	10253	539	5280	15533	7470	6791	29794	455	334
1992	8844	1629	1043	11590	586	6531	18121	7641	8455	34217	469	345
1993	9110	1678	1043	12159	635	7450	19609	7817	10122	37549	483	354
1994	9384	1726	1043	12216	686	8085	20301	7998	11985	40284	497	364
1995	9667	1781	1043	12216	738	8695	20911	8181	13265	42357	513	376
1996	9955	1832	1043	12216	789	9294	21510	8369	13313	43192	528	386
1997	10255	1889	1043	12216	846	9963	22179	8563	13313	44055	543	400
1998	10562	1944	1043	12216	901	10610	22826	8757	13313	44896	560	411
1999	10878	2002	1043	12216	959	11291	23507	8961	13313	45781	578	423
2000	11205	2064	1043	12216	1021	12018	24234	9167	13313	46714	593	437
2001	11541	2125	1043	12216	1082	12735	24951	9378	13313	47642	610	449
2002	11888	2189	1043	12216	1146	13487	25703	9593	13313	48609	630	463
2003	12245	2255	1043	12216	1212	14261	26477	9813	13313	49603	649	477
2004	12612	2321	1043	12216	1278	15038	27254	10038	13313	50805	666	489
2005	12990	2393	1043	12216	1350	15881	28097	10271	13313	51681	690	508
2006	13378	2464	1043	12216	1421	16716	28932	10506	13313	52751	709	521
2007	13781	2538	1043	12216	1495	17583	29799	10749	13313	53860	729	536
2008	14195	2614	1043	12216	1571	18476	30692	10998	13313	55001	753	554
2009	14621	2693	1043	12216	1650	19405	31621	11248	13313	56182	775	569
2010	15056	2773	1043	12216	1730	20344	32560	11506	13313	57379	799	587
2011	15512	2857	1043	12216	1814	21330	33546	11773	13313	58629	821	603
2012	15978	2941	1043	12216	1898	22315	34531	12047	13313	59865	846	622
2013	16456	3032	1043	12216	1989	23385	35601	12319	13313	61233	870	641
2014	16949	3121	1043	12216	2078	24429	36645	12603	13313	62556	896	661
2015	17457	3217	1043	12216	2174	25557	37773	12992	13313	63979	927	681

STUDY:ISLKIDEG; CALC:CENTRAL; TBL:C1; CASES: GHILL GLN GRN OXN PSL STP WAS

ISLAND LAKE AREA ENERGY FORECAST 1980/81 TO 2015/16
GARDENHILL ,3-0 PCT POP. GROWTH, 7.10 TO 5.43 PRS PER HOUSE
PLUS:GODS LAKE NARROWS ,3.00 PCT POP. GROWTH,6.986 TO 5.43 PRS PER HOUS
PLUS:GODS RIVER ,3.00 PCT POP. GROWTH,6.41 TO 5.43 PRS PER HOUSE
PLUS:OXFORD HOUSE ,3.00 PCT POP. GROWTH,5.757 TO 5.43 PRS PER HOUSE
PLUS:RED SUCKER LAKE ,3.00 PCT POP. GROWTH,7.32 TO 5.43 PRS PER HOUSE
PLUS:STE THERESA POINT,3.00 PCT POP. GROWTH,8.391 TO 5.43 PRS PER HOUSE
PLUS:WASAGOMACH ,3.00 PCT POP GROWTH ,7.488 TO 5.43 PRS PER HOUSE
CENTRAL SYSTEM SUPPLY- NO RESIDENTIAL ELECTRIC HEAT
TABLE 2A
BASE YEAR 1980

YEAR	KWH TOTAL HOUSE CONSUMP'N	RED LIGHTING LOAD KW	PROV LIGHTING LOAD KW	OTHER LIGHTING LOAD KW	RED HEATING LOAD KW	PROV HEATING LOAD KW	OTHER HEATING LOAD KW	KWH TOTAL C + M + S CONSUMP'N	PEAK DEMAND KW
1980	4643	4045	425	1276	0	0	0	10560	2411
1981	4798	4146	435	1307	0	0	0	10885	2485
1982	5423	4248	450	1352	0	0	0	11736	2680
1983	5194	4353	460	1383	0	0	0	11638	2654
1984	5440	4464	470	1414	0	0	0	12037	2746
1985	5698	4577	482	1446	0	0	0	12449	2841
1986	5966	4696	493	1479	0	0	0	12882	2941
1987	6656	4822	505	1516	238	119	28	14220	3263
1988	9043	4950	516	1548	1511	239	180	16094	3686
1989	10626	5078	529	1584	2910	359	349	21618	6141
1990	12338	5142	540	1620	4308	308	513	25070	7155
1991	15533	5056	552	1658	5704	406	679	30128	8597
1992	18121	5361	566	1697	7102	506	846	34562	9864
1993	19609	5504	578	1735	8500	607	1012	37902	10816
1994	20301	5631	591	1776	10067	719	1199	40648	11600
1995	20911	5758	605	1815	11143	796	1328	42733	12195
1996	21510	5892	619	1857	11183	799	1332	43581	12438
1997	22179	6028	633	1900	11183	799	1332	44455	12687
1998	22826	6166	647	1944	11183	799	1332	45307	12929
1999	23507	6308	665	1989	11183	799	1332	46204	13186
2000	24234	6454	679	2036	11183	799	1332	47151	13456
2001	24951	6600	695	2081	11183	799	1332	48091	13725
2002	25703	6753	710	2130	11183	799	1332	49072	14005
2003	26477	6909	727	2179	11183	799	1332	50080	14291
2004	27254	7067	743	2228	11183	799	1332	51094	14583
2005	28097	7230	760	2280	11183	799	1332	52189	14894
2006	28932	7396	778	2333	11183	799	1332	53272	15202
2007	29799	7567	798	2386	11183	799	1332	54396	15523
2008	30692	7740	812	2442	11183	799	1332	55555	15855
2009	31621	7919	833	2497	11183	799	1332	56751	16197
2010	32560	8100	850	2553	11183	799	1332	57966	16544
2011	33546	8286	870	2614	11183	799	1332	59232	16904
2012	34531	8478	890	2673	11183	799	1332	60508	17267
2013	35601	8673	912	2735	11183	799	1332	61874	17658
2014	36645	8872	933	2798	11183	799	1332	63222	18043
2015	37773	9076	954	2862	11183	799	1332	64659	18454

STUDY:ISLKIDEG; CALC:CENTRAL; TBL:C1A; CASES: GHILL GLN GRN OXN PSL STP WAS

TABLE 2-14 - CASE 7

ISLAND LAKE AREA ENERGY FORECAST 1980/81 TO 2015/16
GARDENHILL ,3-0 PCT POP. GROUTH, 7.10 TO 5.70 PRS PER HOUSE
PLUS:GODS LAKE NARROWS ,3.00 PCT POP. GROUTH,6.986 TO 5.70 PRS PER HOUS
PLUS:GODS RIVER ,3.00 PCT POP. GROUTH,6.41 TO 5.70 PRS PER HOUSE
PLUS:OXFORD HOUSE ,3.00 PCT POP. GROUTH,5.757 TO 5.70 PRS PER HOUSE
PLUS:RED SUCKER LAKE ,3.00 PCT POP. GROUTH,7.32 TO 5.70 PRS PER HOUSE
PLUS:STE THERESA POINT,3.00 PCT POP. GROUTH,8.391 TO 5.70 PRS PER HOUSE
PLUS:WASAGGOMACH ,3.00 PCT POP GROUTH ,7.488 TO 5.70 PRS PER HOUSE
CENTRAL SYSTEM SUPPLY
TABLE 2
BASE YEAR 1980

YEAR	ESTIMATED POPUL'N	REQ'D HOUSES	OLD HOUSES	MWH CONSUMP'N OLD HOUSES	NEW HOUSES	MWH CONSUMP'N NEW HOUSES	MWH TOTAL HOUSE CONSUMP'N	MWH ESTIMATED COMMER'L CONSUMP'N	MWH ESTIMATED COMMER'L HEATING	MWH TOTAL COMMER'L - HOUSES	ESTIMATED NO. OF ST LIGHTS	MWH ESTIMATED ST LIGHT CONSUMP'N
1980	5004	893	893	4843	0	0	4843	5745	0	10388	234	172
1981	6390	963	893	4457	70	341	4798	5689	0	10686	269	199
1982	6581	997	893	4881	104	542	5423	6087	0	11510	307	226
1983	6778	1043	893	4452	150	742	5194	6229	0	11423	292	213
1984	6982	1092	893	4452	199	988	5440	6370	0	11810	308	227
1985	7193	1143	893	4452	250	1244	5696	6516	0	12212	322	236
1986	7408	1197	893	4452	304	1514	5966	6667	0	12633	339	249
1987	7630	1253	912	4906	341	2138	7044	6820	283	14147	358	261
1988	7860	1311	1030	7131	281	5866	12997	6976	1800	21773	374	275
1989	8094	1374	1043	6067	331	7781	15848	7138	3464	26450	394	290
1990	8338	1439	1043	8950	396	9308	18258	7303	5128	30669	413	303
1991	8588	1507	1043	10253	464	10905	21158	7470	6791	35419	433	318
1992	8844	1552	1043	11590	509	11965	23555	7641	8455	39651	447	330
1993	9110	1598	1043	12159	555	12045	25204	7817	10122	43143	459	337
1994	9384	1646	1043	12216	603	14171	26387	7996	11985	46370	474	348
1995	9667	1695	1043	12216	652	15323	27539	8181	13265	48985	488	358
1996	9955	1746	1043	12216	703	16521	28737	8369	13313	50419	503	369
1997	10255	1800	1043	12216	757	17793	30009	8563	13313	51885	517	380
1998	10562	1852	1043	12216	809	19013	31229	8757	13313	53299	533	392
1999	10878	1909	1043	12216	866	20352	32568	8961	13313	54842	550	405
2000	11205	1964	1043	12216	921	21647	33863	9167	13313	56343	565	414
2001	11541	2025	1043	12216	982	23079	35295	9378	13313	57986	583	428
2002	11888	2086	1043	12216	1043	24512	36728	9593	13313	59634	600	442
2003	12245	2148	1043	12216	1105	25969	38185	9813	13313	61311	619	456
2004	12612	2214	1043	12216	1171	27521	39737	10038	13313	63088	638	468
2005	12990	2277	1043	12216	1234	29002	41218	10271	13313	64802	655	482
2006	13378	2346	1043	12216	1303	30622	42839	10506	13313	66657	675	497
2007	13781	2418	1043	12216	1375	32314	44530	10748	13313	68591	695	510
2008	14195	2491	1043	12216	1448	34030	46246	10998	13313	70555	717	526
2009	14621	2565	1043	12216	1522	35769	47985	11248	13313	72546	738	542
2010	15058	2641	1043	12216	1598	37556	49772	11508	13313	74591	760	559
2011	15512	2722	1043	12216	1679	39458	51674	11770	13313	76757	783	575
2012	15976	2802	1043	12216	1759	41338	53554	12042	13313	78909	806	593
2013	16456	2887	1043	12216	1844	43336	55552	12319	13313	81184	830	611
2014	16949	2972	1043	12216	1929	45332	57548	12603	13313	83464	857	630
2015	17457	3063	1043	12216	2020	47472	59688	12892	13313	85893	881	648

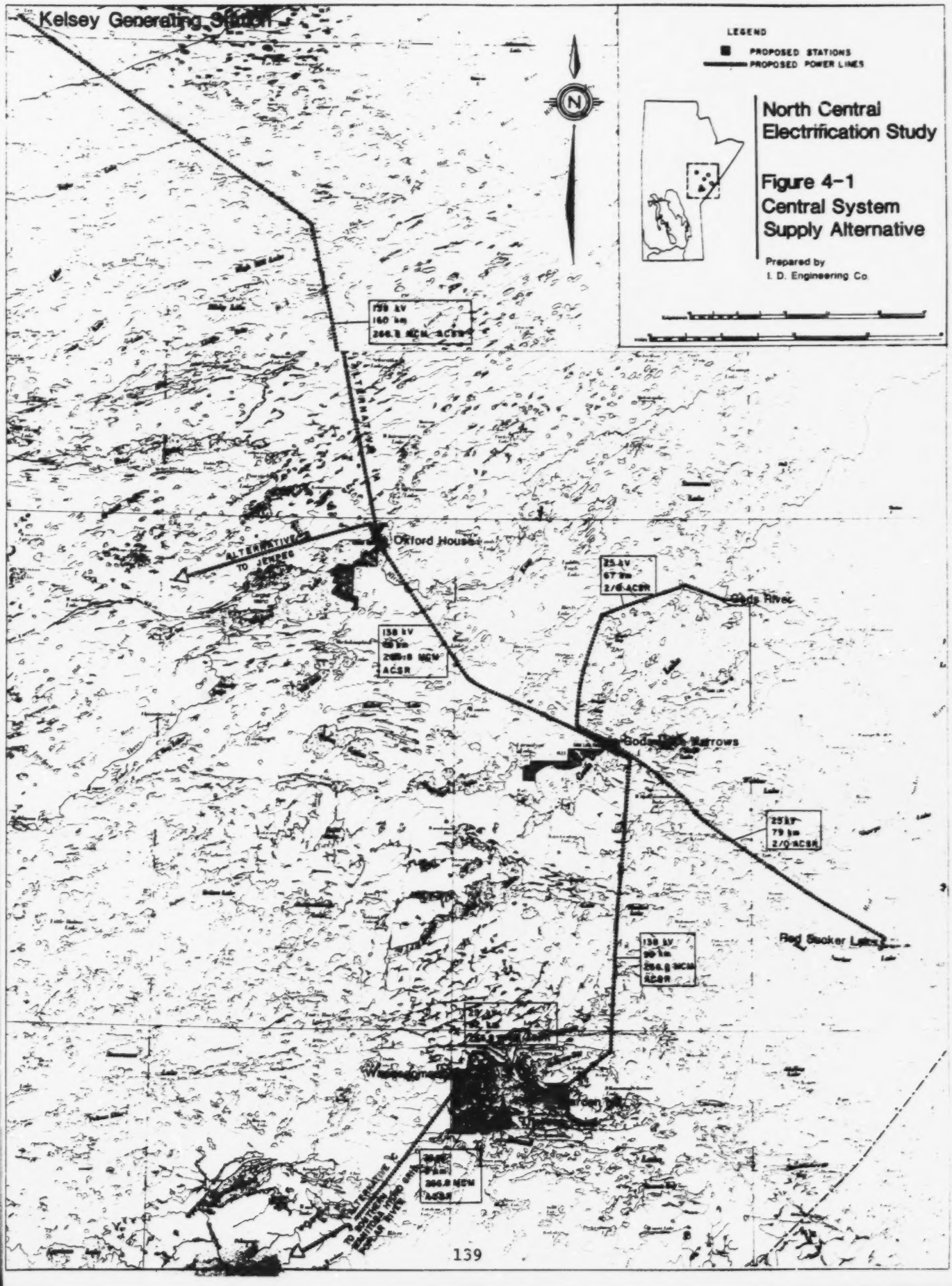
STUDY:ISLKJ10 ; CALC:CENTRAL; TBL:C1; CASES: GHILL GLN GRIV OXH RSL STP WAS

ISLAND LAKE AREA ENERGY FORECAST 1980/81 TO 2015/16
GARDENHILL ,3-0 PCT POP. GROUTH, 7.10 TO 5.70 PRS PER HOUSE
PLUS:GODS LAKE NARROWS ,3.00 PCT POP. GROUTH,6.986 TO 5.70 PRS PER HOUS
PLUS:GODS RIVER ,3.00 PCT POP. GROUTH,6.41 TO 5.70 PRS PER HOUSE
PLUS:OXFORD HOUSE ,3.00 PCT POP. GROUTH,5.757 TO 5.70 PRS PER HOUSE
PLUS:RED SUCKER LAKE ,3.00 PCT POP. GROUTH,7.32 TO 5.70 PRS PER HOUSE
PLUS:STE THERESA POINT,3.00 PCT POP. GROUTH,8.391 TO 5.70 PRS PER HOUSE
PLUS:WASAGGOMACH ,3.00 PCT POP GROUTH ,7.488 TO 5.70 PRS PER HOUSE
CENTRAL SYSTEM SUPPLY
TABLE 2A
BASE YEAR 1980

YEAR	MWH TOTAL HOUSE CONSUMP'N	FED LIGHTING LOAD MW	PROV LIGHTING LOAD MW	OTHER LIGHTING LOAD MW	FED HEATING LOAD MW	PROV HEATING LOAD MW	OTHER HEATING LOAD MW	MWH TOTAL C + I + S CONSUMP'N	PEAK DEMAND MW
1980	4843	4045	425	1276	0	0	0	10560	2411
1981	4798	4148	435	1307	0	0	0	10885	2486
1982	5423	4285	450	1352	0	0	0	11798	2690
1983	5194	4393	460	1383	0	0	0	11636	2657
1984	5440	4484	472	1414	0	0	0	12037	2748
1985	5696	4587	482	1446	0	0	0	12448	2841
1986	5966	4695	493	1479	0	0	0	12882	2941
1987	7044	4823	505	1515	206	17	28	14209	3474
1988	12997	4972	516	1548	1511	106	180	22048	6211
1989	15848	5028	526	1584	2910	208	347	26740	7632
1990	18258	5142	540	1620	4308	308	513	30592	8844
1991	21158	5256	552	1658	5704	408	679	35737	10198
1992	23555	5383	566	1697	7102	508	846	39981	11411
1993	25204	5504	578	1735	8500	607	1012	43460	12409
1994	26387	5631	591	1776	10067	719	1199	46718	13333
1995	27539	5756	605	1816	11143	796	1328	49343	14081
1996	28737	5892	619	1857	11183	799	1332	50788	14495
1997	30009	6028	633	1900	11183	799	1332	52265	14917
1998	31229	6166	647	1944	11183	799	1332	53691	15325
1999	32568	6308	665	1989	11183	799	1332	55247	15765
2000	33863	6454	679	2036	11183	799	1332	56757	16198
2001	35295	6600	695	2081	11183	799	1332	58414	16670
2002	36728	6753	710	2130	11183	799	1332	60078	17144
2003	38185	6909	727	2179	11183	799	1332	61787	17627
2004	39737	7067	743	2228	11183	799	1332	63556	18138
2005	41218	7230	760	2280	11183	799	1332	65284	18632
2006	42838	7356	778	2333	11183	799	1332	67154	19165
2007	44530	7567	796	2386	11183	799	1332	69101	19721
2008	46246	7740	812	2442	11183	799	1332	71081	20286
2009	47985	7919	833	2497	11183	799	1332	73088	20857
2010	49772	8100	850	2553	11183	799	1332	75150	21447
2011	51674	8286	870	2614	11183	799	1332	77332	22070
2012	53554	8478	890	2673	11183	799	1332	79502	22689
2013	55552	8673	912	2735	11183	799	1332	81795	23343
2014	57548	8872	933	2798	11183	799	1332	84094	23998
2015	59688	9076	954	2862	11183	799	1332	86541	24698

STUDY:ISLKJ10 CALC:CENTRAL; TBL:C1A; CASES: GHILL GLN GRIV OXH RSL STP WAS

TABLE 2-15 - CASE 8


Kelsey Generating Station
LEGEND
PROPOSED STATIONS
PROPOSED POWER LINES
North Central
Electrification Study
Figure 4-1
Central System
Supply Alternative
Prepared by
I. D. Engineering Co
Oxford House
Gods River
Red Sucker Lake
ALTERNATIVE
TO JENPEG

CENTRAL SYSTEM SUPPLY

CONSTRUCTION SCHEDULE

(CASH FLOW)

ALTERNATIVE A

Year 1 (Construction Period: September to August)	1983 $ x 10^3
1. Clear Right-of-Way: Kelsey to Oxford House 160 km (488 ha)	
- 488 ha at $2,470/ha	1,205.
2. Construct 138 kV Transmission Line: Kelsey to Oxford House (160 km)	9,120.
3. Construct Kelsey Station Extension:	1,200.
4. Construct Transformer Stations	
- Oxford House (138 - 12 kV)	1,400.
- Gods Lake Narrows (138 - 25 kV)	3,000.
TOTAL YEAR 1	15,925.

Communities on Central System Supply:

- Oxford House

Year 2 (Construction Period: September to August)	1983 $ x 10^3
5. Clear Right-of-Way:	
- Gods Lake Narrows to Oxford House 75 km (229 ha, at $2,470/ha)	565.
- Gods Lake Narrows to Garden Hill 90 km (275 ha, at $2,470/ha)	678.

6. Construct 138 kV Transmission Lines:	
- Gods Lake Narrows to Oxford House (75 km)	4,275.
- Gods Lake Narrows to Garden Hill (90 km)	5,130.
7. Construct Transformer Station:	
- Garden Hill (138 25 kV)	1,650.
8. Convert 12 kV Distribution System to 25 kV:	
- Garden Hill	334.
- Gods Lake Narrows	168.
TOTAL YEAR 2	12,800.

Communities on Central System Supply:

- Oxford House
- Gods Lake Narrows
- Garden Hill

Year 3 (Construction Period: September to August)

	1983 $ x 10^3
9. Clear Right-of-Way:	
- Gods Lake Narrows to Red Sucker Lake 79 km (241 ha, at $2,470/ha)	595.
- Gods Lake Narrows to Gods River 67 km (204 ha, at $2,470/ha)	505.
- Garden Hill to St. Theresa Point (via Waasagomach) 41 km (125 ha at $2,470/ha)	309.
10. Construct 25 kV Transmission Line:	
- Gods Lake Narrows to Gods River (67 km)	1,876.
- Gods Lake Narrows to Red Sucker Lake (79 km)	2,212.
- Garden Hill to Waasagomach (32 km)	896.
- Waasagomach to St. Theresa Point (9 km)	252.

11. Convert 12 kV Distribution System to 25 kV:

- Gods River	28.
- Red Sucker Lake	37.
- St. Theresa Point	163.
- Waasagomach	161.
TOTAL YEAR 3	7,034.

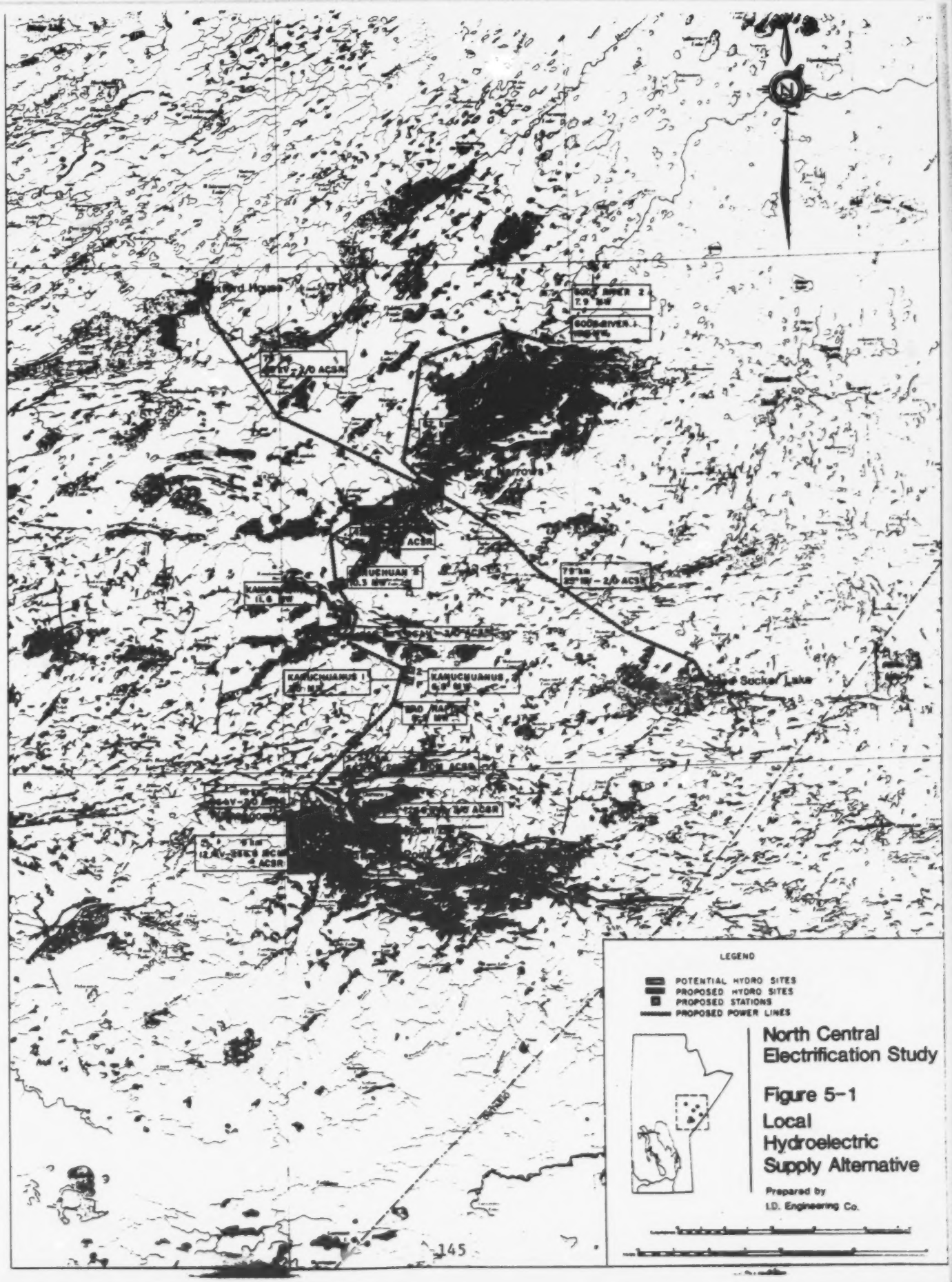
Communities on Central System Supply:

- Oxford House
- Gods Lake Narrows
- Garden Hill
- Gods River
- Red Sucker Lake
- St. Theresa Point
- Waasagomach

Table 5-1

Summary of Available Base Data

Watershed	Site Name	Installed Capacity MW	Minimum Firm Flow CU. M.	Head M
Island Lake River	Bad Rapids	8.2	70.8	10.0
	Kanuchuanus #1	7.0	70.8	8.5
	Kanuchuanus #2	6.8	70.8	8.2
Kanuchuan River	Kanuchuan #1	11.6	87.8	11.3
	Kanuchuan #2	10.3	87.8	10.0
Gods River	Gods River #1	7.9	113.3	6.0
	Gods River #2	10.5	113.3	8.0


LEGEND
POTENTIAL HYDRO SITES
PROPOSED HYDRO SITES
PROPOSED STATIONS
PROPOSED POWER LINES
North Central Electrification Study
Figure 5-1
Local Hydroelectric Supply Alternative
Prepared by
I.D. Engineering Co.

Bad Rapids Site
(looking upstream)

Kanuchuanus Site 1
(looking downstream)

Kanuchuanus Site 2
(looking upstream)

FIGURE 5-2 ISLAND LAKE RIVER SITES

Table 5-2

Basic Site Data for Potential Hydro Developments
on the Island Lake River

	Bad Rapids	Kanuchuanus #1	Kanuchuanus #2
Installed Capacity	8.2 MW	7 MW	6.8 MW
Design Flow	70.8 CU. M.	70.8 CU. M.	70.8 CU. M.
Rated Head	10 M.	8.5 M.	8.2 M.
Height of Dam	12 M.	6 M.	7 M.
Length of Dam	1000 M.	733 M.	300 M.
Flood Flow	433 CU. M.	433 CU. M.	433 CU. M.
No. of Units	3	3	3
Penstock Length	24 M.	50 M.	50 M.
Penstock Diameter	4.2465 M.	4.40107 M.	4.436 M.
Penstock Thickness	12.8081 MM.	13.0013 MM.	13.045 MM.
Transmission Line Length	0.1 KM.	1 KM.	1 KM.
Access Road Length	5 KM.	12 KM.	12 KM.
Distance to Town	100 KM.	100 KM.	100 KM.
Distance to Concrete Plant	100 KM.	100 KM.	100 KM.

Table 5-3

Estimated Capital Cost of Potential Hydro Developments on Island Lake River

Millions of 1983 Dollars

	Bad Rapids	Kanuchuanus #1	Kanuchuanus #2
Earthfill Dam	3.69	1.30	0.68
Spillway	4.67	3.23	3.48
Intake	2.31	2.31	2.31
Penstock	0.55	1.21	1.23
Unwatering	1.63	1.62	1.62
Powerhouse Civil	2.62	2.42	2.39
Equipment Supply	5.25	4.85	4.79
Equipment Erection	1.57	1.45	1.43
Access Road	0.45	0.94	0.94
Transmission Line and Substation	0.01	0.11	0.11
Fishway	0.80	0.40	0.47
Overhead Costs	10.17	7.76	7.56
Engineering and Owners Costs	5.41	4.53	4.44
	39.13	32.13	31.45

Kanuchuan Site 1 (looking upstream)

Kanuchuan Site 2 (looking downstream)

FIGURE 5-3 KANUCHUAN RIVER SITES

Table 5-4

Basic Site Data for Potential Hydro Developments
on the Kanuchuan River

	Kanuchuan #1	Kanuchuan #2
Installed Capacity	11.6 MW	10.3 MW
Design Flow	87.7 CU. M.	87.8 CU. M.
Rated Head	11.3 M.	10 M.
Height of Dam	13 M.	11 M.
Length of Dam	770 M.	800 M.
Flood Flow	505 CU. M.	505 CU. M.
No. of Units	3	3
Penstock Length	0 M.	20 M.
Penstock Diameter	4.53241 M.	4.65821 M.
Penstock Thickness	13.1655 MM.	13.3228 MM.
Transmission Line Length	1 KM.	1 KM.
Access Road Length	12 KM.	12 KM.
Distance to Town	100 KM.	100 KM.
Distance to Concrete Plant	100 KM.	100 KM.

Table 5-5

Estimated Capital Cost of Potential Hydro Developments on Kanuchuan River

Millions of 1983 Dollars

	Kanuchuan #1	Kanuchuan #2
Earthfill Dam	3.23	2.71
Spillway	5.51	5.00
Intake	2.80	2.80
Penstock	-	0.53
Unwatering	1.90	1.90
Powerhouse Civil	3.40	3.20
Equipment - Supply	6.79	6.41
- Erection	2.03	1.91
Access Road	0.94	0.94
Transmission Line and Substation	0.13	0.12
Fishway	0.87	0.74
Overhead Costs	11.67	10.87
Engineering and Owners Costs	6.20	5.90
	45.47	43.03

Gods River Site 1 (looking downstream)

Gods River Site 2 (looking downstream)

FIGURE 5-4 GODS RIVER SITES

Table 5-6

Basic Site Data for Potential Hydro Developments
on Gods River

	Gods River #1	Gods River #2
Installed Capacity	7.9 MW	10.5 MW
Design Flow	113.3 CU. M.	113.3 CU. M.
Rated Head	6 M.	8 M.
Height of Dam	8 M.	10 M.
Length of Dam	300 M.	420 M.
Flood Flow	596 CU. M.	596 CU. M.
No. of Units	3	3
Penstock Length	0 M.	0 M.
Penstock Diameter	5.81624 M.	5.45953 M.
Penstock Thickness	14.7703 MM.	14.3244 MM.
Transmission Line Length	2.5 KM.	23 KM.
Access Road Length	12 KM.	12 KM.
Distance to Town	100 KM.	100 KM.
Distance to Concrete Plant	100 KM.	100 KM.

Table 5-7

Estimated Capital Cost of Potential Hydro Developments on Gods River

Millions of 1983 Dollars

	Gods River #1	Gods River #2
Earthfill Dam	0.78	1.36
Spillway	4.78	5.39
Intake	3.52	3.52
Penstock	-	-
Unwatering	2.24	2.24
Powerhouse Civil	3.06	3.54
Equipment - Supply	6.11	7.07
- Erection	1.82	2.11
Access Road	0.94	0.94
Transmission Line and Substation	0.26	2.07
Fishway	0.54	0.67
Overhead Costs	9.94	11.06
Engineering and Owners Costs	5.45	6.29
	39.44	46.26

Table 5-8

Hydro Electric Alternative
Transmission Grid

Capital Cost Estimate

Refer to Figure 5-1

	1983 $ X 10^3	
66 kV Transmission Lines		
Oxford House to Gods Lake Narrows 75 km, #2/0 Conductor	2,100.	
Gods Lake Narrows to Kanuchuan 1 & 2 42 km, #2/0 Conductor	1,176.	
Kanuchuan 1 & 2 to Bad Rapids 42 km, #2/0 Conductor	1,176.	
Bad Rapids to Waasagomach 42 km, #2/0 Conductor	1,176.	
Garden Hill to tap north of Waasagomach 25 km, #2/0 Conductor	700.	
Subtotal 66 kV Transmission		6,328.
25 kV Transmission		
Gods Lake Narrows to Gods River 67 km, #2/0 ACSR	1,876.	
Gods Lake Narrows to Red Sucker Lake 79 km, #2/0 ACSR	2,212.	
Subtotal 25 kV Transmission		4,088.
12 kV Transmission		
Waasagomach to St. Theresa Point 9 km, 266.8 MCM ACSR Conductor	288.	
Subtotal 12 kV Transmission		288.

	1983 $ X 10^3	
Transformer Station Costs		
Oxford House, 66-12 kV Transformer Station	1,200.	
Gods Lake Narrows, 66-25 kV Transformer Station	2,000.	
Waasagomach, 66-12 kV Transformer Station	1,200.	
Garden Hill, 66-12 kV Transformer Station	1,200.	
Subtotal Transformer Station Costs		5,600.
12 to 25 kV Conversion		
Gods Lake Narrows	168.	
Gods River	28.	
Red Sucker Lake	37.	
Subtotal Conversion Costs		233.
Clearing of Right-of-Way		
Assume a 30 Metre Wide Right-of-Way for all Transmission Lines		
All Right-of-Ways to be Cleared by Man Power		
Total Line Length - 381 km 1162 ha at $2,470. per ha		
Subtotal Right-of-Way Clearing		2,870.
Communication		100.
TOTAL TRANSMISSION GRID COSTS (Hydro Electric Alternative)		19,507.

Table 5-9

Local Hydro and Thermal Alternative
Transmission Grid

Construction Schedule

(Cash Flow)

	1983 $ X 10^3
YEAR 1	
1. Clear Right-Of-Way:	
Gods Lake Narrows to Gods River (67 km, 204 ha)	505.
St. Theresa Point to North of Waasagomach (19 km, 58 ha)	143.
Garden Hill to North of Waasagomach (25 km, 76 ha)	188.
2. Construct Transmission Lines:	
Gods Lake Narrows to Gods River (66 kV, 67 km)	1,876.
St. Theresa Point to Waasagomach (12 kV, 9 km)	288.
Garden Hill to North of Waasagomach (66 kV, 25 km)	700.
Waasagomach to North of Waasagomach (66 kV, 10 km)	280.
TOTAL YEAR 1	3,980.
YEAR 2	
3. Clear Right-Of-Way:	
Gods Lake Narrows to North of Waasagomach (116 km, 354 ha)	874.
Oxford House to Gods Lake Narrows (75 km, 229 ha)	565.

4.	Construct Transmission Lines:	
	Gods Lake Narrows to North of Waasagomach (66 kV, 116 km)	3,248.
	Oxford House to Gods Lake Narrows (66 kV, 75 km)	2,100.
5.	Construct Substations:	
	Oxford House (66-12 kV)	1,200.
	Gods Lake Narrows (66-25 kV)	2,000.
	Waasagomach (66-12 kV)	1,200.
	Garden Hill (66-12 kV)	1,200.
	Improve Communication	50.
	TOTAL YEAR 2	12,437.

YEAR 3

6.	Clear Right-of-Ways:	
	Gods Lake Narrows to Red Sucker Lake (79 km, 241 ha)	595.
7.	Construct Transmission Lines:	
	Gods Lake Narrows to Red Sucker Lake (25 kV, 79 km)	2,212.
8.	Convert Distribution Systems:	
	Gods Lake Narrows (12 to 25 kV)	168.
	Gods River (12 to 25 kV)	28.
	Red Sucker Lake (12 to 25 kV)	37.
	Improve Communication	50.
	TOTAL YEAR 3	3,090.

Table 7-1

Local Hydro Generation Alternative
Development Sequence Based On
Least Cost per kW

Year	Peak Power Demand (kW)	Existing Installed Capacity (kW)	Site			
			Kanuchuan #1 (kW)	Kanuchuan #2 (kW)	Bad Rapids (kW)	Total Hydro Capacity (kW)
1980	2,411	6,325				
1981	2,485	6,325				
1982	2,675	6,325				
1983	2,628	6,325				
1984	2,708	6,325				
1985	2,788	6,325				
1986	2,878	6,325				
1987	3,377	6,325				
1988	4,967	6,325				
1989	6,980	6,325	11,600			11,600
1990	8,149	6,325	11,600			11,600
1991	9,880	6,325	11,600			11,600
1992	11,067	6,325	11,600			11,600
1993	12,182	6,325	11,600	10,300		21,900
1994	13,154	6,325	11,600	10,300		21,900
1995	14,104	6,325	11,600	10,300		21,900
1996	14,631	6,325	11,600	10,300		21,900
1997	15,041	6,325	11,600	10,300		21,900
1998	15,468	6,325	11,600	10,300		21,900
1999	15,912	6,325	11,600	10,300		21,900
2000	16,368	6,325	11,600	10,300		21,900
2001	16,839	6,325	11,600	10,300		21,900
2002	17,307	6,325	11,600	10,300		21,900
2003	17,795	6,325	11,600	10,300		21,900
2004	18,286	6,325	11,600	10,300		21,900
2005	18,782	6,325	11,600	10,300		21,900
2006	19,295	6,325	11,600	10,300		21,900
2007	19,833	6,325	11,600	10,300		21,900
2008	20,370	6,325	11,600	10,300		21,900
2009	20,937	6,325	11,600	10,300		21,900
2010	21,489	6,325	11,600	10,300		21,900
2011	22,080	6,325	11,600	10,300	8,200	30,100
2012	22,678	6,325	11,600	10,300	8,200	30,100
2013	23,278	6,325	11,600	10,300	8,200	30,100
2014	23,904	6,325	11,600	10,300	8,200	30,100
2015	24,536	6,325	11,600	10,300	8,200	30,100

Table 7-2

Local Thermal Generation Alternatives
Development Sequence

Year	Peak Demand	Installed Capacity	Units Installed				Total New Capacity
			#1 & #2	#3	#4	#5	
	kW	kW	kW	kW	kW	kW	kW
1980	2,411	6,325					
1981	2,485	6,325					
1982	2,675	6,325					
1983	2,628	6,325					
1984	2,708	6,325					
1985	2,788	6,325					
1986	2,878	6,325					
1987	3,377	6,325					
1988	4,967	6,325					
1989	6,980	6,325	10,000				10,000
1990	8,149	6,325	10,000				10,000
1991	9,880	6,325	10,000	5,000			15,000
1992	11,067	6,325	10,000	5,000			15,000
1993	12,182	6,325	10,000	5,000			15,000
1994	13,154	6,325	10,000	5,000			15,000
1995	14,104	6,325	10,000	5,000			15,000
1996	14,631	6,325	10,000	5,000			15,000
1997	15,041	6,325	10,000	5,000			15,000
1998	15,468	6,325	10,000	5,000	5,000		20,000
1999	15,912	6,325	10,000	5,000	5,000		20,000
2000	16,368	6,325	10,000	5,000	5,000		20,000
2001	16,839	6,325	10,000	5,000	5,000		20,000
2002	17,307	6,325	10,000	5,000	5,000		20,000
2003	17,795	6,325	10,000	5,000	5,000		20,000
2004	18,286	6,325	10,000	5,000	5,000		20,000
2005	18,782	6,325	10,000	5,000	5,000		20,000
2006	19,295	6,325	10,000	5,000	5,000		20,000
2007	19,833	6,325	10,000	5,000	5,000		20,000
2008	20,370	6,325	10,000	5,000	5,000	5,000	25,000
2009	20,937	6,325	10,000	5,000	5,000	5,000	25,000
2010	21,489	6,325	10,000	5,000	5,000	5,000	25,000
2011	22,080	6,325	10,000	5,000	5,000	5,000	25,000
2012	22,678	6,325	10,000	5,000	5,000	5,000	25,000
2013	23,278	6,325	10,000	5,000	5,000	5,000	25,000
2014	23,904	6,325	10,000	5,000	5,000	5,000	25,000
2015	24,536	6,325	10,000	5,000	5,000	5,000	25,000

NOTE: Since diesel units and biomass units are the same size this installation sequence applies to both thermal alternatives.

APPENDIX B

ENVIRONMENTAL IMPACT ASSESSMENT

ENVIRONMENTAL IMPACTS OF A CENTRAL SYSTEM SUPPLY ALTERNATIVE

Regardless of the exact location chosen, if a transmission line system is to be built to and between the seven communities, the environmental impacts of constructing and operating the system along with the potential mitigation measures can be predicted. Hundreds of miles of various types of transmission lines have been constructed in northern Manitoba, many of them through areas very similar to the study area (i.e., the Nelson River hydro-electric system).

This assessment therefore presumes that the environmental impacts, necessary mitigative measures, and the residual impacts of constructing and operating a transmission line from the Kelsey generating station to and between the seven communities will be similar to those experienced with other northern transmission lines. However, in this presentation, it is assumed that some environmental impacts produced by previous construction need not be repeated. With proper environmental planning and awareness, changes in construction procedures, and mitigation consideration, many impacts can be reduced or eliminated.

Typical Transmission Line Construction

Transmission line rights-of-way are generally established from air photo interpretation combined with ground truthing. Major obstacles such as lakes and large rivers are avoided. In order to minimize capital costs, the

shortest possible route is normally chosen and wherever possible the route is planned for high ground.

A right-of-way width is chosen depending on the size of the transmission line, and the right-of-way is hand and/or machine cleared of all trees. Clearing and construction generally takes place in winter when terrain similar to the study area is to be traversed. Temporary construction camps are usually established for each phase of construction. Work is optimally carried out for a distance of 20-25 km on either side of the work camps. Temporary access roads may be constructed on or adjacent to the right-of-way for hauling people and supplies or for accessing borrow pits.

These temporary access roads are used by a wide range of light and very heavy equipment many times a day and as a result, require considerable maintenance. Special roads may be constructed from supply terminals or marshalling yards located along the route in order to haul in equipment, machinery or supplies. Helicopters are frequently used to haul in some equipment and materials in extremely rough terrain or over poor terrain not suitable for construction operations. At the completion of construction, the machinery is moved out, the temporary access roads removed, and the scars on the landscape are left to regenerate naturally.

This environmental overview has been carried out to show the impacts of the transmission line clearing and construction regardless of the season. Therefore, if any of the construction were to take place in summer, the potential impacts will have been identified prior to the construction

being carried out. If the construction took place during winter only, it will be obvious that some of the impacts would not occur and others would be minimized.

Historic Resources

In general, a 30-meter-wide right-of-way does not usually significantly impact on archaeological resources. The potential for impact on archaeological sites increases at stream crossings, and especially at rapids. There is also potential for damage to pictographs on rock walls, should they occur near stream crossings.

In order to mitigate any potential damage to archaeological sites, the potential right-of-way would have to be examined by an archaeologist during the environmental impact assessment. The examination would include a review of archive data for known sites and a ranking of terrain potential for sites from aerial photo. Mitigation could include line routing to avoid sites and exploratory digs to evaluate terrain with high ranking potential. This mitigation would be carried out prior to final selection of the exact route. If any sites were discovered along a prefered route during construction, these would be evaluated. If the evaluation determined that the sites were significant, the transmission line right-of-way could be moved so as to preserve the sites, the sites could be excavated, or the sites could be hand-cleared and avoided by equipment in order to preserve them. If the transmission line were to be constructed in the winter, equipment passing over the site would not necessarily damage or destroy the sites if the frozen ground was not disturbed.

Pictographs could be protected and preserved from vandalism simply by prohibiting access and/or by informing the construction crews of their value.

If the route crossed known or high potential archaeological sites, there would be a cost to Manitoba Hydro to prove and evaluate or excavate the sites, to hand-clear the sites, or to possibly reroute the transmission line. The cost would vary depending on site significance and number of sites.

Fisheries

The only environmental concern for fish populations and aquatic resources would be at stream crossings. The province has an established set of stream crossing guidelines called "Recommended Fish Protection Procedures for Stream Crossings in Manitoba".

If these recommendations are followed, impacts would be negligable. Winter construction and the use of ice bridges would negate any potential impacts that could occur as a result of construction being carried out in periods of open water conditions. The environmental impact assessment would require on site evaluation of all stream crossings prior to construction.

Forestry

Conditions related to the clearing of rights-of-way are generally set out by the Forestry Branch of the Department of Natural Resources prior to the start of a clearing operation. These specify the rules with regard to timber salvage, brushing, slash disposal, and burning. If a line is cleared and constructed during summer, there is the risk of construction operations accidentally starting forest fires. If the transmission line crossed a timber sale area, the timber could be harvested and given to the sale operator. If the line were to cross a timber stand that was not a sale area, the salvageable timber may be given to the clearing contractor or to the Indian Bands closest to the location. No other mitigation would probably be necessary. The existence of a cleared right-of-way may also prove beneficial for accessing previously inaccessable merchantable timber stands.

Wildlife

Line clearing and construction may cause a temporary disturbance to wildlife but it is doubtful that any significant critical habitat destruction would occur. If construction took place in winter, the potential disturbance impacts on wildlife would be reduced. The right-of-way clearing will produce an "edge effect" which will create a variety of wildlife habitats along timbered sections of the line. The right-of-way will also enhance access into previously inaccessible areas. This could be detrimental to ungulate populations as this access usually results in increased hunting pressure along the lines, especially by Treaty Indians who can hunt year round. The only miti-

gation presently available is for resource managers to adjust sport hunting seasons and quotas if necessary to compensate for the increased ungulate kill by Treaty Indians.

Trapping

Right-of-way clearing and line construction could impact upon all of the registered traplines along the route of the right-of-way. The impacts would be temporary and, if the line were constructed in winter, would result in wildlife disturbance or disruption of trapping operations. Construction may also require the removal or replacement of existing trapper cabins on or near the right-of-way.

If construction took place in one or more winter seasons, it would be necessary to compensate the affected trappers for loss of production for those seasons only and for moving or replacing affected trapping cabins. The environmental impact assessment would determine and evaluate those registered traplines which would be impacted by line clearing and construction. For example, individual trapline production figures would be obtained from the Minister of Natural Resources to determine the average annual production for the last five to ten years for each impacted trapline. This average for each trapline would then be used on a base with which to compare future production during line construction. The difference, if one occurs, may then be the amount of compensation payment due to the individual trapper.

Where trapline cabins have to be replaced, they could be evaluated by an independent appraiser.

Since line clearing in forested areas will result in new habitats from edge effect, and with disturbance factors removed, compensation would not be necessary after the last construction year.

After construction, trapping may improve because of the edge effect. Trappers may also benefit from improved access to traplines.

Recreation

Recreational concerns will be primarily for the visual impact of the clearing and transmission line on aesthetic values of the area and on recreational developments. A review of existing recreational developments in the area shows that there are none near the proposed transmission line. Consideration will have to be given, however, to the recreational developments in the vicinity of the communities - notably Gods River (Rominsky's Lodge). Stream crossings should be required to avoid scenic rapids. These individual sites would be evaluated during the environmental impact assessment.

Rare and Endangered Species

Clearing and construction activities may impact rare and endangered plant and animal species. To prevent this, investigations are normally initiated in the environmental impact assessment. Contacts would be made with provincial wildlife agencies and the Museum of Man and Nature to see if there are any known or recorded rare and endangered species along the transmission corridor. The agencies would make recommendations for the preservation of such occurrences.

ENVIRONMENTAL IMPACTS OF
LOCAL HYDRO GENERATION ALTERNATIVE

During the investigations carried out seven potential small hydroelectric generating station sites in the Gods Lake and Island Lake area were identified.

The environmental impacts from the right-of-way clearing, construction and operation of the transmission line grid would be the same as those described for the transmission line connection to the Central Grid. The impacts associated with the construction and operation of small hydroelectric generating sites are presented here. In considering the potential impact one must also consider that only three sites would be developed by the year 2015. The remaining four sites would not be developed until the middle or the later part of the twenty-first century.

A review of historic water levels (1933 to 1979) shows that normal seasonal water level fluctuations on Gods Lake generally range from 0.5 m to 1.5 m. In the extreme, the lake level has reached a recorded minimum-maximum difference of 2.2 m. Seasonal lake level fluctuations on Island Lake generally range from 0.5 m to 1 m. There was insufficient information to state that the required storage can be developed by drawdown below current normal water levels only. It is therefore considered that approximately half of the required storage would be provided above existing water levels.

If this occurs, however, the 0.75 m increase in lake level would fall within the normal seasonal lake level fluctuations (0.5 m to 1.5 m). The following environmental impact assessment then is based on the premise that small hydro generation installations may dampen the extremes in lake level fluctuations (except in years of unseasonally high or low water levels), and will tend to hold the lakes at more constant levels with less fluctuation.

Fisheries

The biggest concern with small hydro-electric generating stations is their potential impact on brook trout populations. The Gods Lake area has one of the few natural brook trout fisheries in Manitoba. Brook trout in the Limestone River off the Nelson have been all but wiped out by angling pressure, making the Gods Lake fishery all the more important. In addition, Nelson River brook trout are largely migrant populations available to anglers only temporarily, whereas Gods Lake brook trout are resident fish. The fish are highly prized by anglers since they can grow to Master Angler size, and are available at any time of the year (O'Connor, personal communication).

A generating station will block fish passage, and although the anticipated designs and cost estimates include fish ladders, it is not known whether brook trout are able to use fish ladders. If the fish are not able to get past the dams, they will concentrate below the structures where they will be vulnerable to overharvest by anglers.

Damming will also cause flooding of rapids, which provide prime brook trout habitat. Brook trout are generally found in the middle of rivers in the fast-flowing water; pike tend to keep to the slower moving water along the riverbanks. Backing up of the river may cause water flow to be slowed throughout, allowing pike to take over the entire stream (Hayden and O'Connor, personal communication).

Tourism

The brook trout fishery is a major drawing-card for lodges in the Gods Lake area. Any impact of the dams on the brook trout population would drastically affect the lodges using this resource. The lodge at Gods River is almost totally dependent on brook trout for attracting its business (Maksymetz, personal communication). Guides from Gods River take numerous clients downstream, and there is an outcamp located approximately 95 km down the river (Hayden and O'Connor, personal communication). Anglers would have to portage around the proposed dam to reach the camp or simply to fish further downstream.

The operators of Stringers Narrows Lodge and Gods Lake Narrows Lodge are primarily concerned with lake trout and walleye but do advertise brook trout angling; they take clients to Kanuchuan Rapids 30 km away. Elk Island Lodge does not emphasize brook trout but also takes clients to Gods River (Maksymetz, personal communication).

Trapping

Riverbank and lakeshore areas provide habitat for primary furbearers such as otter, muskrat, and mink. The proposed dams would cause flooding of lower willow or marsh areas along Gods River if Site 2 was developed, and along some stretches of the Island Lake River if any of those three sites were developed. Furbearers would probably relocate but there may be a reduction in furbearer populations along the affected stretches of the rivers. Trappers working the affected Registered Traplines (RTLs) would experience some loss in fur production. A development at Site 2 on Gods River may affect 60 km of shoreline and there would be flooding of low-lying areas along those shorelines. The impact of developments at all other sites would be considerably reduced because of the steep gradients of those rivers. The length of impacted shorelines at those sites would generally be in the order of 3 km to 5 km.

A major concern with large hydro dams is that they reverse normal water flows below the dam. Beaver and muskrat establish themselves at the low summer water levels and then are flooded out in winter when the dam creates higher water levels than normal (Stardom, personal communication). This is unlikely to be a problem with the small dams since their effect will be one of damping fluctuations in water levels. As a result, lake levels should become more constant.

Also with regard to large dams, many trappers' complaints centre on access to their traplines. Ice forms at the highest level of the lake or

river. Drawdown in winter then results in the formation of shelf ice on lakes or weak ice downstream from the dams and as a result trappers have to take circuitous routes or cross dangerous ice to reach their traplines (Stardom, personal communication). With smaller dams, weak ice may become a problem around the dam site, however, most of the proposed sites are at rapids and would have presented a problem anyway. In fact, backing up of the water and flooding former rapids may allow good ice to form at these sites, creating more crossing points than would be available to trappers prior to the flooding.

If any of the sites are developed, trappers would have to be compensated for income loss.

Heritage Resources

The only archaeological survey that has been done of the Gods Lake area was conducted in the late 1960's by the National Museum, and it concentrated primarily on the lake. However, certain areas have a high probability of providing archaeological sites. Rapids have high potential since they require portaging around and are generally good fishing spots where people may have stopped to camp. Most of the proposed dam sites are located at rapids on the rivers. Areas of shallow overburden near the rapids would have to be checked; any remains of campsites would be readily detected since a few inches of soil can contain thousands of years of history (Dickson, personal communication).

Most of the dams considered are to be in rock channel areas in an effort to contain flooding to the river channel. Steep rock cliffs are prime sites for pictographs, and these have been found around Gods Lake. Painted from a canoe, pictographs would be fairly close to the water line and could be easily covered over by only minor increases in water level (Dickson, personal communication). Historic resources along lakeshores should not be impacted because lake levels should not exceed natural lake level fluctuations.

Although documentation of archaeological sites in the area is minimal, the potential for such sites is high at most of the considered dam locations.

Site-Specific Concerns

Gods River - Site 1

This site does not have noticeable rapids, however, water would be backed up removing any rapids between the site and Gods Lake. Water flow upstream of the site may be slowed, enabling pike to take over former brook trout habitat. In addition, anglers would have to portage around the dam to reach resident brook trout populations downstream. The Gods River is heavily used by the lodges. There is also an outcamp about 95 km downriver from the lake (O'Connor, personal communication).

Heritage resources are not a major concern at the Gods River Site 1 itself since there are no rapids to portage; however, rapids upstream are

likely to be good fishing spots associated with campsites. There are also no steep rock outcrops, thus pictographs are not a concern at Site 1. Again, there may be potential sites upstream.

RTLs 10 and 12 of Gods Lake RTL section would be directly affected by flooding caused by a dam at Gods River Site 1.

Gods River - Site 2

A dam at this site would have a greater impact than one at Site 1 since it is much further downstream and would back up water over almost 30 km of river. Fisheries and heritage resource concerns discussed previously would apply to all sets of rapids between Site 2 and Site 1.

RTLs 10 and 12 would also be affected.

Kanuchuan - Sites 1 and 2

These two sites are close together and generating stations at these sites would have similar effects. Both would have a major impact on brook trout; water would be backed up affecting numerous sets of rapids on the Kanuchuan River. All fisheries and heritage resource concerns would apply to each set of rapids.

An existing abandoned generating station at Kanuchuan has a water flow through the structure and over a spillway. The station is located par-

allel to the river rapids in a man-made channel. Brook trout concentrate downstream of the spillway. The Fisheries Branch (Hayden and O'Connor, personal communication) stated that because of the open water, brook trout are fished year round at the site. Thus, brook trout at Kanuchuan are already experiencing heavy angling pressure and could be severely impacted by another dam further downstream from the existing abandoned site.

River flooding will impact RTLs 45 and 46 of Gods Lake RTL section.

Kanuchuanus - Sites 1 and 2

The sites are close together and would back up water affecting a few rapids. Again, there would be fisheries and heritage resource concerns at every set of rapids, including Bad Rapids. Heritage resources are of particular importance since pictographs have been documented in the vicinity of Kanuchuanus Rapids, although the exact site is not known.

Flooding would occur in RTLs 10, 11, and 12 of Island Lake RTL section.

Bad Rapids

A dam at Bad Rapids would flood a few rapids up to 3 km upstream. The same fisheries and heritage resource concerns would apply as with the other proposed damsites. The same traplines would be affected as with the Kanuchuanus sites.

APPENDIX C

ENVIRONMENTAL DATA FOR OTHER ALTERNATIVES

ENVIRONMENTAL CONSIDERATIONS

Since none of the alternatives described herein are considered technically or economically attractive alternatives, a detailed environmental review has not been conducted.

For the purpose of environmental review, the following balances are provided with respect to the biomass and diesel systems.

Biomass System Balance and Emissions

Heat Input	-	100.00	
Electrical Power Output	-	(-) 15.00	
Losses:			
Stack Loss	-		26.50
C.W. Loss	-		26.30
T-G System Loss	-		18.70
Station Auxiliaries	-		7.00
Ash and Unburns	-		4.70
Radiation and Other Loss	-		1.80
Total Losses:		85.00%	85.00%

It is estimated that typical order of magnitude stack gas emissions for a station of 11,600 kW capacity would be as follows:

Emission	Tonnes per Hour
Total Gas	144
Particulates	0.10 - 0.18
H_2O	13.6
CO_2	2.0
SO_2	0.02

Diesel System Balance and Emissions

Heat Input	-	100.00	
Electrical Power Output	-	(-) 41.7	
Losses:			
Stack Loss	-		32.0
Charge Air Cooling	-		12.3
Engine and Turbine Cooling	-		6.8
Lube Oil Cooling	-		4.1
Alternator Loss	-		1.4
Radiation	-		1.7
Total Losses:		58.3%	58.3%

Gaseous emissions from isolated diesel engine generators are not generally a matter of environmental concern.

Photovoltaic Systems

These are clean and non-polluting systems, and are the most environmentally acceptable of all power generation systems.